

**RESEARCH TO IMPROVE WATER-USE
EFFICIENCY AND CONSERVATION:
TECHNOLOGIES AND PRACTICES**

**HEARING
BEFORE THE
SUBCOMMITTEE ON ENERGY AND
ENVIRONMENT
COMMITTEE ON SCIENCE AND
TECHNOLOGY
HOUSE OF REPRESENTATIVES
ONE HUNDRED TENTH CONGRESS**

FIRST SESSION

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RESEARCH TO IMPROVE WATER-USE EFFICIENCY AND CONSERVATION: TECHNOLOGIES AND PRACTICES

TUESDAY, OCTOBER 30, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 2:05 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Lampson [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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Subcommittee on Energy and Environment

Hearing on

***Research to Improve Water-Use Efficiency and Conservation:
Technologies and Practices***

Tuesday, October 30, 2007
2:00 p.m. to 4:00 p.m.
2318 Rayburn House Office Building

Witness List

Dr. Glen Daigger
Senior Vice President, CH2M HILL World Headquarters

Mr. Ron Thompson
District Manager, Washington County Water Conservancy District

Mr. Ed Clerico
President, Alliance Environmental

Ms. Val Little
Director, Water Conservation Alliance of Southern Arizona (Water CASA), & Principal Research Specialist, College of Architecture and Landscape Architecture, University of Arizona

Mr. John A. Veil
Manager Water Policy Program, Argonne National Laboratory

HEARING CHARTER

**SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES**

**Research to Improve Water-Use
Efficiency and Conservation:
Technologies and Practices**

TUESDAY, OCTOBER 30, 2007
2:00 P.M.-4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Tuesday, October 30, 2007 the Subcommittee on Energy and Environment of the Committee on Science and Technology will hold a hearing to receive testimony on H.R. 3957, the *Water-Use Efficiency and Conservation Research Act of 2007*. The purpose of the hearing is to evaluate the need for research and development of technologies and processes to enhance water-use efficiency and water conservation. The Committee will also ascertain perspectives on current federal efforts to promote water-use efficiency and conservation through programs such as the WaterSense Program of the Environmental Protection Agency (EPA).

Need for Legislation

The dwindling supply of water in the United States has created increasing concern at all levels of government. Since 1950, the United States population has increased nearly 90 percent. In that same period, public demand for water has increased 209 percent. Americans now use an average of 100 gallons of water per person each day. This increased demand has put additional stress on water supplies and distribution systems, threatening both human health and the environment.

Approximately 26 billion gallons of water are used every day in the United States and thirty six states are anticipating local, regional, or statewide water shortages by 2013. However, some states are already in the middle of a severe drought. Most of the Southeastern United States, stretching from Tennessee across the Carolinas and into Georgia, is suffering from an exceptional drought, the highest intensity as measured by the U.S. Drought Monitor. The city of Atlanta is bracing as experts argue whether the city water supply will last as few as three months or as many as nine months.

In California, catastrophic fires burned across areas of the southern part of the state this week. Extreme drought conditions over the past two years have played a large role in creating the conditions that made such a disaster possible. More than 500,000 people were evacuated from their homes at the height of the fires, the largest number in California history. Over 2,000 homes and at least 180 commercial buildings were destroyed or damaged. The drought gripping the West is considered by some experts to be the worst in 500 years, with effects in the Colorado River basin that have been considerably more damaging than during the Dust Bowl years, according to scientists at the U.S. Geological Survey. Compounding the problem, the Colorado River had its highest flow of the 20th century from 1905 to 1922, the years used as the basis for allocating the River's water between the Upper and Lower Colorado Basin states under the Colorado River Compact.

Climate change related effects are expected to exacerbate already scarce water resources in many areas of the country. The Intergovernmental Panel on Climate Change's (IPCC) 2007 assessment states that water stored in glaciers and snow cover is projected to decline, reducing water availability to one-sixth of the world's population that relies upon melt water from major mountain ranges. The IPCC also predicts droughts will become more severe and longer lasting in a number of regions.

Although some water efficiency strategies require an initial capital investment, in the long run, conserving water provides significant cost savings for water and wastewater systems. Water efficiency and reuse programs help systems avoid,

down-size, and postpone expensive infrastructure projects, by developing new water supplies.

Introduced by Representative Jim Matheson, H.R. 3957 would establish a research and development program within the Environmental Protection Agency's Office of Research and Development (ORD) to promote water efficiency and conservation. The program would collect and disseminate information on water conservation practices. Through this program, EPA will be able to encourage the adoption of technologies and processes that will achieve greater water-use efficiency thereby helping to address the water supply shortages in the United States.

H.R. 3957 would expand EPA's scope and involvement solving the Nation's water crisis by researching innovations in water storage and distribution systems, as well as, behavioral, social, and economic barriers to achieving greater water efficiency. In addition, the program will research technologies and processes that enable the collection, treatment, and reuse of rainwater and greywater, waste water from sinks, baths and kitchen appliances.

Background on EPA's Current Water Research and Outreach Programs

EPA currently has no research and development effort that addresses water supply issues. In conjunction with its statutory responsibilities to ensure water quality under the *Clean Water Act* and the *Safe Drinking Water Act*, EPA has a program of research and development on water treatment technologies, health effects of water pollutants, security from deliberate contamination, and watershed protection. Current annual funding for these activities is approximately \$50 million. EPA does not have a research and development program to address water-use efficiency or conservation.

In June of 2006, EPA created a voluntary program entitled WaterSense, which focuses on educating consumers about available choices to save money and conserve water. Similar to Energy Star ratings, the WaterSense label indicates the performance of an appliance or product with respect to its water-use efficiency. Products displaying a WaterSense label must achieve water use reductions of at least 20 percent over similar appliances and products. In FY07, EPA obligated \$2.4 million in funding for the WaterSense Program.

Under the program's structure, manufacturers certify that products with the WaterSense label met EPA criteria for water efficiency and performance. Currently, the program has reviewed High-Efficiency Toilets, and plans on expanding its scope to include bathroom faucets, weather-based irrigation controllers, commercial toilets and faucets, and autoclave water valves. EPA estimates that if all U.S. households installed water-efficient appliances, the country would save more than three trillion gallons of water and more than \$17 billion dollars per year. In addition, the average American household could save 20,000 gallons of water per year if it installed an inexpensive low-flow showerhead. A low-flush toilet could reduce their water use by an additional 34 percent.

At present, there is a lack of significant federal research and development aimed at addressing water-use efficiency and conservation, especially focused on residential and commercial uses. Because of the Agency's complementary work on water quality, the EPA is the logical federal entity to complete this research due to the important relationship between water supply and water quality.

Current State Initiatives on Water Efficiency

Many states and local governments are taking action to promote greater water-use efficiency and conservation including: metering and sub-metering, rebates for purchase of water efficient products, use of drought tolerant landscaping, processed water use, greywater and rainwater utilization, and correcting infrastructure leaks.

Because water supplies are controlled by local, regional and State government, a variety of approaches are being tested and implemented. While there are many benefits to having a diversity of creative efforts, the establishment of a central repository for information on the approaches and their costs and benefits is lacking. H.R. 3957 directs EPA to gather this information and provide a central location for distributing information about successful projects that have been implemented by communities across the country to achieve greater adoption of technologies and policies on water conservation.

Listed below are some examples of such efforts.

- The city of Tucson, Arizona has been active in the promotion of xeriscaping; a practice of landscaping which does not require supplemental irrigation. Common plants used in this practice include agave, cactus, lavender, juniper, sedum and thyme. Each year, a xeriscaping conference is held in Tucson, as well as a contest awarding the best xeriscaping project. City policy prevents

the use of municipal groundwater supplies for irrigating areas within public rights-of-way unless the landscaping uses plants from a low water-use list.

- The State of New York passed legislation to establish a Green Building Tax Credit, which allows building owners and developers to deduct expenses associated with the design and construction of “green” buildings, which includes a number of water-use efficient practices.
- The city of Austin, Texas has instituted a highly successful appliance replacement rebate plan to encourage consumers to purchase water-use efficient toilets, clothes washers, and irrigation equipment. Austin’s Water Conservation Program has contributed to a substantial reduction in per capita water use. In 2006, the Austin City Council formed the Water Conservation Task Force to find ways to implement a June 2006 directive to implement aggressive water conservation measures. The anticipated recommendations include changes to the plumbing code, a retrofit on resale for inefficient plumbing fixtures, mandatory irrigation analyses for large commercial properties, and stricter summer watering regulations. Together, the measures should result in peak-day water savings of nearly 33 million gallons per day at an average cost of roughly \$1.13 per gallon, one-third the cost of building new treatment capacity.
- The Santa Rosa Subregional Reclamation System in Northern California is one of the largest recyclers of water in the world. Last year 6,400 acres of farmlands, vineyards, and public and private urban landscaping was irrigated with recycled water. Of that, 85 percent was used for agricultural purposes. The irrigation system is supported by storage reservoirs that can hold over 1.45 billion gallons of water. The Subregional System serves the cities of Santa Rosa, Rohnert Park, Sebastopol, Cotati, the South Park Sanitation District, and some unincorporated parts of Sonoma County. In addition, the Subregional System pipes its treated wastewater to a geothermal energy plant to be used as re-injection fluid, thereby prolonging the life of the reservoir while recycling the treated wastewater. The addition of wastewater produces close to 85 megawatts of electricity a day, enough to supply the residential energy needs of Santa Rosa.
- The Pennsylvania Water Conservation Leak Detection Program is a joint effort of the Pennsylvania Department of Environmental Protection and the Pennsylvania Rural Water Association (PRWA). PRWA uses set-aside funds to provide two circuit riders to conduct water audits and perform leak detection for small systems (serving fewer than 10,000 persons). Despite the time-consuming nature of the project, the circuit riders have detected 594 leaks and saved over 1.4 billion gallons of water and \$1.36 million annually. From June 2001 to July 2002, 24 systems underwent water audits. A total of 152 leaks were detected, which saved systems over 396 million gallons of water from 36 percent to nine percent.

Witnesses

Glen Daigger, Vice President at CH2MHill

Dr. Daigger is a Senior Vice President and Chief Technology Officer for CH2M Hill. He received a B.S., M.S., and Ph.D. in Civil Engineering from Purdue University. He is the recipient of numerous awards, including the Kappe and Freese Lectures and the Harrison Prescott Eddy, Morgan, and the Gascoigne Awards from Water Environment Federation. A member of a number of professional societies, Dr. Daigger is also a member of the National Academy of Engineers.

Ed Clerico, CEO of Alliance Environmental and Designer at the Solaire Project in NYC

Mr. Clerico is a licensed professional engineer and licensed wastewater operator in NY, NJ, and PA and is an accredited LEED professional. He holds a B.S. and M.S. in Bio-Ag Engineering from Rutgers University. He was the founder and president of Applied Water Management, Inc. before holding executive roles with American Water as Technical Development Director and VP Strategy. Presently, he operates his own consulting business, Alliance Environmental, and focuses on initiatives that involve integrated water management, including the Solaire project in New York City.

Val Little, Director of the Water Conservation Alliance of Southern Arizona

Ms. Little is the Director of the Water Conservation Alliance of Southern Arizona. In addition, she serves as a Principal Research Specialist at the University of Arizona’s College of Architecture and Landscape Architecture. She received her A.B. in

Landscape Architecture from the University of California, Berkeley, and her M.A. in Anthropology from the University of Arizona.

Ron Thompson, District Manager of the Washington County Water Conservancy District

Mr. Thompson is the District Manager of the Washington County Water Conservancy District. He graduated from Brigham Young University in 1971 with a degree in Accounting and received his law degree from the University of Utah in 1974. Mr. Thompson is a past president of the Utah Water Users Association, Vice Chairman of the Resolutions Committee for the National Water Resources Association, and Vice Chairman of the Resolutions Committee for the Colorado River Water Users. He also serves on the Board of Trustees of the Utah Water Finance Agency, State of Utah Drinking Water Board, and serves as the Utah representative for the National Water Resources Endangered Species Task Force.

John Veil, Senior Scientist at Argonne National Laboratory

Mr. Veil is the Manager of the Water Policy Program for Argonne National Laboratory in Washington, DC, where he holds the rank of senior scientist. He analyzes a variety of energy industry water and waste issues for the Department of Energy. Mr. Veil has a B.A. in Earth and Planetary Science from Johns Hopkins University, and two M.S. degrees, in Zoology and Civil Engineering, from the University of Maryland. Before joining Argonne, Mr. Veil managed the Industrial Discharge Program for the State of Maryland government where he had statewide responsibility for industrial water pollution control permitting through the National Pollutant Discharge Elimination System (NPDES), Underground Injection Control (UIC), and oil control programs.

Section-by-Section description of H.R. 3957

Title: *Water-Use Efficiency and Conservation Research Act 2007*

Purpose: To increase research, development, education, and technology transfer activities related to water use efficiency and conservation technologies and practices at the Environmental Protection Agency (EPA).

Section 1: Short Title

The Water-Use Efficiency and Conservation Research Act.

Section 2: Findings

Section 2 includes the Congressional findings and defines the need for expanding the scope of research and development conducted by the Environmental Protection agency to include water-use efficiency and conservation to address the problems of increasing water shortages across the country.

Section 3: Research Program

Section 3 directs the Assistant Administrator to establish a research, development, and demonstration program within the Environmental Protection Agency's Office of Research and Development to promote water-use efficiency and conservation. The bill provides examples of several areas the program should address including water storage and distribution systems; and behavioral, social, and economic barriers to achieving greater water-use efficiency. In addition, the bill states the program should research technologies and processes that enable the collection, treatment, and reuse of rainwater and greywater. The specific projects selected for funding through the program should reflect the needs identified by local and State water managers.

Section 4: Technology Transfer

Section 4 directs the Assistant Administrator to collect and disseminate information on current water-use efficient and conservation technologies and practices to facilitate their adoption. This information should include incentives and impediments to development and commercialization, best practices, and anticipated increases in water-use efficiency resulting from the implementation of these processes.

Section 5: Report

Section 5 directs the Assistant Administrator to report to Congress on the progress being made by the Environmental Protection Agency with regard to the research projects initiated, and the outreach and communication activities conducted through the program.

Section 6: Authorization of Appropriations

Section 6 provides a five-year authorization of the program with such sums as necessary to carry out the program.

Chairman LAMPSON. This meeting will now come to order. I wish you all a good afternoon and welcome to today's hearing on expanding research to improve water-use efficiency and conservation. The Subcommittee is here to receive testimony on H.R. 3957, the *Water-Use Efficiency and Conservation Research Act of 2007*, introduced by good friend Jim Matheson. Congressman, I want to thank you for your hard work and interest on this important subject.

The world is covered by some 70 percent of water and less than three percent of it is freshwater. According to the United Nations Commission on Sustainable Development, a mere .007 of a percent of the Earth's total freshwater resources is accessible for human usage. Pollution and salinization enhanced by drought conditions only serve to decrease the water available for our use.

Drought and scarce water supplies have long been a problem for my home State of Texas. Population growth, increased energy demand, and climate change impacts are further endangering my state's limited supply. I think this is the first year in many that there has not been a significant drought any place in the State of Texas.

The Texas Water Development Board estimated demand for water use will exceed water supply in Texas by the year 2050. This story is repeating itself across the country. This year's epic drought in the Southeast threatens the water supply for millions. Water levels in the Great Lakes have been declining. Upstate New York's reservoirs have dropped to records lows. And in the West, the mountain snow pack is melting earlier and faster, affecting freshwater supplies for all of those who rely on snowmelt-fed rivers.

We cannot solve these problems overnight, but H.R. 3957 will provide us with several important tools to address the coming crisis with technology and innovative thinking. By encouraging research and development into water-use efficiency, we can create a path to increase our nation's water supplies.

Investing in water-use efficiency strategies requires some expenditure now, but in the long run, conserving water provides substantial costs savings for governments and the American public. The Environmental Protection Agency estimates that if all U.S. household installed water-efficient appliances, the country would save more than three trillion gallons of water and more than \$17 billion per year.

I want to thank our distinguished panel for traveling to testify at this afternoon's hearing. I look forward to your testimony and to your recommendations as to how we can make better use of our scarce water resources. Thank you.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

Good Afternoon and welcome to today's hearing on expanding research to improve water-use efficiency and conservation. The Subcommittee is here to receive testimony on H.R. 3957, the *Water-Use Efficiency and Conservation Research Act of 2007*, introduced by my good friend Jim Matheson. Congressman, I want to thank you for your hard work and interest on this important subject.

Although the world is covered by 70 percent water, less than three percent of it is freshwater. According to the United Nations Commission on Sustainable Development, a mere .007 percent of the Earth's total freshwater resources is accessible for human use. Pollution and salinization enhanced by drought conditions only serve to decrease the water available for our use.

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I want to thank our distinguished panel for traveling to testify at this afternoon's hearing. I look forward to your testimony and to your recommendations as to how we can make better use of our scarce water resources.

Chairman LAMPSON. And I recognize the Ranking Member, Mr. Inglis, for his opening remarks.

Mr. INGLIS. Thank you, Mr. Chairman, and thank you for holding this hearing. I also appreciate Mr. Matheson's work to introduce H.R. 3957, the *Water-Use Efficiency and Conservation Research Act*. This bill highlights the need to think more conservatively about invaluable water resources.

We don't have to look far to realize the devastating effect of water shortages and what they can do to our lives: fires that threaten and destroy California, droughts that debilitate crops in South Carolina and a number of other Southeastern states, and global citizens who have to travel farther and farther to reach freshwater.

By supporting research and development into enhanced water-use efficiency and water conservation, the Federal Government can help improve our national and global response to water shortage.

I am looking forward to hearing from our witnesses today about the type of research technologies best suited to meet this goal. Mr. Chairman, I will also ask the Environment Protection Agency, the agency tasked with carrying out the provisions of this bill, to look at the legislation and provide comments on it. Since the agency was not provided—was not asked to provide a witness today, I think it only appropriate that we agree to take their comments into consideration as we move the bill through the legislative process.

Thank you, again, Mr. Chairman, and I look forward to discussing the bill with the panel.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Thank you for holding this hearing, Mr. Chairman. I also appreciate Mr. Matheson's work to introduce H.R. 3957, the *Water-Use Efficiency and Conservation Research Act*. This bill highlights the need to think more conservatively about invaluable water resources.

We don't have to look far to realize the devastating effects water shortages can have in our lives—fires threaten and destroy California, droughts debilitate crops in South Carolina and a number of other southeastern states, and global citizens have to travel farther and farther to have access to fresh water. By supporting research and development into enhance water-use efficiency and water conservation,

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Thank you again, Mr. Chairman, and I look forward to discussing this bill before the Subcommittee.

Chairman LAMPSON. Thank you, Mr. Inglis, and I certainly will take note of your request. It makes sense.

I ask unanimous consent that all additional opening statements submitted by the Subcommittee Members be included in the record. Without objection, so ordered.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Mr. Chairman, I appreciate the Subcommittee looking into this issue today, as the recent droughts in the southeastern part of our country have highlighted the need for research and development surrounding water conservation.

It is clear that our nation's rapid growth over the twentieth century has placed a great deal of stress on our natural resources. Americans now use an average of 100 gallons of water per person each day. Although the EPA has conducted research and development on water treatment technologies and ensures quality drinking water under the *Clean Water Act* and *Safe Drinking Water Act*, there is currently no research and development that address water supply issues. Sustaining and protecting our water supplies will affect every district in America, which is why it is so important to conduct this hearing today.

Mr. Chairman, now is clearly the time to act to research, collect information under one body, and begin the process to better protect our natural resources. I commend you on the timeliness of this hearing, and I look forward to learning about the possibilities for action. Thank you.

Chairman LAMPSON. It is my pleasure to introduce some of our witnesses today. We will start with Dr. Glen Daigger, who is a Senior Vice President with CH2M Hill, where he is currently the chief technology officer for the firm's civil infrastructure businesses. He is also a technology fellow in wastewater treatment, serving as senior consultant and process engineer on municipal and industrial wastewater treatment and reclamation projects. Mr. Ed Clerico is a water reuse expert and an accredited LEED professional, licensed professional engineer, and licensed wastewater operator in New York, New Jersey, and Pennsylvania. Mr. Clerico is currently President of Alliance Environmental, a consulting group that focuses on green-building concepts.

And at this time, we have several Members here today who will be introducing the remainder of our witnesses. First, I would like to yield to the author of H.R. 3957, Mr. Matheson.

Mr. MATHESON. Well, thank you, Mr. Chairman, and I am pleased to introduce a constituent of mine, Ron Thompson, who is the District Manager of the Washington County Water Conservancy District. Mr. Thompson participates on so many different boards and associations, I am not sure I can read through all of them. I want to tell you, this is an individual who faces some real challenges in a county that is one of the fastest-growing counties in the United States. It is also one of the most arid counties in the United States, and he has a wealth of experience and knowledge about how to meet those challenges, with a portfolio approach. One

piece of that portfolio has to do with conservation and efficiency, and so, I am pleased that he could come here today and participate as a witness on this panel.

I will yield back, Mr. Chairman.

Chairman LAMPSON. Thank you, Mr. Matheson. The gentlelady from Arizona, Ms. Giffords.

Ms. GIFFORDS. Thank you. I am pleased to introduce a constituent of mine who is the Director of the Water-Conservation Alliance of Southern Arizona, also known as Water Casa. She is also a principal research specialist with the University of Arizona's college of architecture and landscape architecture. She is the author of numerous water-use efficiency publications, and has worked internationally on water-conservation issues, ranging from the Middle East to Central America.

I have had a chance to work with Ms. Little in my early days in the Arizona State legislature, where we collaborated on legislation that created the incentives for homebuilders to initiate greywater plumbing systems in new-home construction.

As a leader in our community, particularly coming from the Sonorian Desert where we don't have a lot of water, Ms. Little has been instrumental in bringing diverse stakeholders together to address the future of water in our desert home. It is my pleasure that she has come all of the way from Southern Arizona to be with us today.

My staff has also informed me that the students of the University of Arizona are now watching the video teleconference to your testimony. Here is a shout out to all of the students at the University of Arizona for participating via the technology of the Internet. I know that we are all working collaboratively to make sure that our water supply remains secure.

Chairman LAMPSON. Thank you, Ms. Giffords. And the gentlelady from Illinois, Ms. Biggert, will introduce our final witness.

Ms. BIGGERT. Thank you, Mr. Chairman, and it is a pleasure for me to introduce Mr. John Veil, a respected senior scientist from Argonne National Laboratory, and manager of its water-policy program. Before joining Argonne, Mr. Veil managed the industrial-discharge program for the State of Maryland and was a faculty member in the department of zoology at the University of Maryland. His biography has a very distinct Maryland theme, despite working for Argonne, which is in my district in Illinois. Mr. Veil is a resident of Maryland, but he is a great asset to the laboratory and to the people of Illinois. He and other water experts from Argonne and Purdue University, Calumet City, are currently working with scientists and engineers at BP to explore the application of emergency technologies that could address wastewater treatment challenges faced by the company at its Whiting, Indiana, oil refinery on Lake Michigan. And millions get their drinking water from Lake Michigan and the other Great Lakes, so that is why many of us in Congress care deeply about this amazing freshwater resource and why Mr. Veil's contributions to protect it are so important. I would like to thank him for being here, and I yield back.

Chairman LAMPSON. Thank you, Ms. Biggert, and I want to thank you and welcome all of our witnesses. We do appreciate your

coming. And as you all know, you will have five minutes for your spoken testimony. Your written testimony will be included in the record for the hearing. When you have completed your testimony, we will begin with questions. Each Member will have five minutes to question the panel.

And Dr. Daigger, we will begin with you.

STATEMENT OF DR. GLEN T. DAIGGER, SENIOR VICE PRESIDENT AND CHIEF TECHNOLOGY OFFICER, CH2M HILL WORLD HEADQUARTERS

Dr. DAIGGER. Thank you, Mr. Chairman. I will generally follow the written testimony here, but I appreciate very much the opportunity to speak to you today to discuss this very important topic. In my over 30 plus years of professional experience, I have worked around the U.S. and around the world, focusing on clean water and sanitation. This is an area that is near and dear to my heart.

I don't need to discuss the urgent need to provide clean water and sanitation in the United States. You have all expressed that need very well. What it leads to, of course, is conflict between urban and rural areas and people and the environment. We are seeing that, certainly in Georgia.

What is important is that there are solutions to these issues, and this bill will help to advance those. And what we do need, though, is your help to help advance these solutions into a practice through demonstration and additional research. So let me provide some perspective in terms of overall direction and how this fits in.

Water has historically been managed in urban areas and public health has been protected by transporting water. A pristine water source is identified. It is conveyed to the public, and it is used to transport waste out of that urban area. There are those that say this is an invention of the 18th and 19th century, but actually you go back to the ancient cities, and this is the approach that was used. So this is something which has been used throughout the history of mankind to manage water in urban areas.

When the population was much lower, and when the burden on the environment was much less, this was really a brilliant solution in terms of protecting public health. The statistics are very clear in terms of its benefit in creating the standard of living that we have in the U.S., and some of those specific comments are in the testimony. The issue, though, is that with population growth, and particularly the urbanization that we have, this approach is really no longer working for us. But fortunately, again, we have an alternative to transportation of water and waste. That is treatment, which is sufficiently reliable to be deployed at a more local basis so that we can use and reuse water much more efficiently.

Some of the most important treatment systems are: membranes, which function much like the kidney in terms of purifying water; ultraviolet disinfection, which mimics sunlight in terms of treating water; and a variety of other technologies. So you might ask, if we have these technologies, what help do we need? The help that we need is to be able to deliver these more quickly into routine practice.

And as I talk about that, let me talk a little bit about—I am a person that is involved in water issues around the world. I want

to talk for a minute about what some other countries are doing. Countries—and you know, this country, in decades past, have made significant public investments in water research and created the systems we have which have really benefited the world. Countries like France and Canada, Japan, and the United Kingdom have emulated that, and quite frankly, a lot of the advancements that are occurring are being developed in other countries. Right now, for example, the Republic of Singapore, with only 4.5 million people, is investing \$330 million in research. Korea is investing \$140 million a year in their water research. So I give that perspective.

What we need is three things. One is help to demonstrate. The second is help to further advance this technology through things like nanotechnology and biotechnology. And then, finally, quite frankly, we need help in terms of our academic investments to maintain a healthy academic system.

At the conclusion of my written testimony, I reiterate that I think something on the order \$100 million in terms of R&D investment, and the academic community needs about \$20 million a year in order to support the faculty and the professionals that we need graduating to continue this wonderful profession that exists in the U.S.

Thank you very much.

[The prepared statement of Dr. Daigger follows:]

PREPARED STATEMENT OF GLEN T. DAIGGER

Mr. Chairman and Members of the Subcommittee, my name is Glen Daigger and I am a Senior Vice President and the Chief Technology Officer for the Civil Infrastructure Client Group of CH2M HILL. I want to thank you for the opportunity to speak before you today, to discuss the very important and timely issue of water resources in our country. My over 30-year professional career has been devoted to securing safe drinking water supplies and sanitation for locations throughout the United States and around the world. I do not need to discuss the urgent need to provide clean water and sanitation for the United States and the world as water scarcity continues to be in the headlines and is a source of conflict between urban areas and agriculture and between people and the environment. Population growth, increasing urbanization, and climate change will only exacerbate the situation and dramatically increase these conflicts. Fortunately solutions are available, but we need your help to further develop, demonstrate, and more quickly deploy them. Let me provide some background and perspective.

Water has historically been managed in urban areas and public health has been protected by *transporting* water. A pristine water source was identified remote from the urban area and transported there. Used water (some refer to this using the more derogatory terms sewage and wastewater) was transported away from the urban area to protect public health by minimizing its contact with the public. "Mother nature" was depended on to treat the used water, thereby reclaiming it and recycling it for subsequent use. Although some think of this as an invention of the 18th and 19th century, this practice actually began with the cities of the ancient world, with gravity providing the force to convey water. The advent of mechanical devices (pumps driven first by steam and later by electrical engines) during the industrial revolution provided greater freedom in the location of cities as the dependence on gravity was eliminated. This approach worked brilliantly when the population of the planet was less than about 1.5 billion (and the population of the U.S. less than 100 million), and only a small fraction of the human population lived in urban areas. For example, the average life span of Americans increased by about 30 years (from 47 years to 76 years), over the 20th century. Twenty of the thirty years of added life span are attributable to clean water and modern sanitation! In fact, when the *British Medical Journal* recently surveyed public health professionals about the single greatest contribution to public health over the past 150 years, modern water systems were ranked first, above such medical revolutions as vaccinations and antibiotics. Unfortunately, this brilliant solution, which worked so well up to the early part of the 20th century, is now insufficient with more than a four fold

increase in population through the 20th century and a dramatic increase in urbanization. Today we are taking too much water out of the environment, and Mother Nature is not able to reclaim and recycle the used water fast enough.

Fortunately, new approaches are available to manage water in urban settings which address these problems. Essentially, *treatment* can replace *transportation*. Increased standards of living have increased water use dramatically, but currently available water saving devices allow water to be used more efficiently, thereby reducing the net demand. While technologies have been available for decades to treat raw water for drinking and used water for return to the environment, new, more reliable treatment technologies are becoming available that allow used water to be reclaimed to potable standards, or better! Thus, we no longer need to return used water to the environment and depend upon Mother Nature to reclaim and recycle it. The historic approach of using transport and discharge to protect public health can be replaced with reclamation and reuse technologies that mimic Mother Nature. The result is more efficient use of water. Consider that urban water use in the United States currently averages about 150 gallons per person per day. Benchmarking with experiences around the world indicates that water conservation can lower this substantially, and the use of water reclamation and reuse can lower this further to 20 to 30 gallons per person per day. The net result is that the amount of water withdrawn from the environment is reduced dramatically.

Three of the most promising treatment technologies include membranes, advanced oxidation, and ultra-violet (UV) light. We all have a treatment device inside of us called the kidney which removes waste products. Membranes function much like the kidney, cleaning water in a highly effective fashion. Membranes can be further coupled with biological treatment processes which use microorganisms to convert pollutants in the used water into harmless by-products. Sunlight is an effective disinfectant and is mimicked by UV systems. Advanced oxidation produces hydroxyl radicals which can very effectively convert recalcitrant contaminants into a form that the microorganisms can consume. These technologies, in concert, can take the most contaminated water and purify it to a quality much better than drinking water. They can be further coupled with evolving urban water management practices such as rainwater harvesting, storm water management using low impact development, and natural treatment systems like wetlands to allow local rainfall and reclaimed water to be used for a variety of purposes and dramatically reduce the reliance of urban areas on transported water.

With all of these developments you might ask why we need your help. The reason is that the benefits of these technologies and approaches can only be realized when they are assembled together properly in an overall integrated urban water management system. Moreover, while the application principals for these new systems are general in nature, the optimum system for any given urban area is relatively site-specific. Thus, a relatively complete system must be assembled before the full range of benefits can be achieved. In short, demonstrations in a variety of settings are required to provide the real-world examples needed by urban water managers to gain support for local implementation.

Support is needed for a second reason. The rapid advances occurring in bio- and nanotechnology offer the potential to greatly increase the effectiveness of these technologies. However, support is needed to further develop these *fundamental* research results into *practical* research results that will support the development of additional breakthrough water treatment technologies. Research funding in the water area is also needed to stem the loss of critical research and educational capacity. Before expanding upon this, let me share some observations about the funding of water research around the world.

The U.S. led the world in developing and implementing revolutionary water management systems throughout the second half of the 20th century. This occurred because of national need but was enabled by consistent federal funding for research that built the strongest network of researchers and educators in the world. Observing the success of this approach, other countries such as Canada, Japan, the United Kingdom, and France emulated this approach in the latter portion of the 20th century, with great success. This approach continues today, especially in a variety of Asian countries which have the same compelling national need and who see that federal funding of water R&D is a great public investment which returns itself many times over by both meeting critical national needs and by creating profitable national and export businesses. For example, the country of Singapore, with a population of 4.5 million people, is investing \$330 million in water R&D over the next five years, and Korea is investing \$140M/yr. The Singapore investment is attracting much larger private sector investments by industrial giants like GE and Siemens. What really worries me is China where the need is critical and the investments they

are making will inevitably create export businesses that will threaten our U.S.-based industry.

The question before us is whether the U.S. is going to give up its leadership in this critical area and fail to live up to its potential to dramatically improve the quality of life in the U.S. and around the world. This is the path that we are on, but it can be reversed with a fairly modest set of actions by the Federal Government. Critical support for R&D in this area of water use-efficiency and conservation is needed to enable the demonstration of these approaches and to support academic research that will advance the technology and also support the continued growth of our educational and research capabilities. Currently the Federal Government provides significant support to local governments for the construction of water and wastewater treatment facilities through the State Revolving Funds. Annual support has varied, but has regularly exceeded \$1 billion/yr. A modest federal R&D investment of \$100 to \$200 million/yr. would catalyze a renewal of the U.S. water industry, with at least \$20 million/yr. going to support academic research. This is the help that we need and, when compared to current federal investments in water and wastewater, we see that it is well within the realm of possibility. Thus, I wholeheartedly support the Discussion Draft developed by Representative Matheson.

Again, I want to thank you for the opportunity to address this critical national need, and I'm prepared to answer any questions you might have.

BIOGRAPHY FOR GLEN T. DAIGGER

Glen T. Daigger is a Senior Vice President with CH2M HILL where he currently serves as Chief Technology Officer for the firm's civil infrastructure businesses (water, operations, and transportation). He is responsible for the people, processes, and tools that deliver technology to serve clients in these business areas. He is also a Technology Fellow in Wastewater Treatment and, consequently, serves as senior consultant and process engineer on a wide variety of municipal and industrial wastewater treatment and reclamation projects. He has provided technical leadership to many landmark projects, including for example numerous biological nutrient removal (BNR) and water reclamation and reuse projects in locations ranging from the Chesapeake Bay and throughout North America to New Zealand, Australia, Singapore, China, Eastern Europe, and the Middle East. In addition to his 28 years with CH2M HILL, Dr. Daigger also served as Professor and Chair of Environmental Systems Engineering at Clemson University.

Dr. Daigger is a recognized expert in wastewater management and in wastewater treatment process and facility design. Areas of special expertise include water reclamation and reuse, nutrient control, fixed film systems, membrane bioreactors (MBRs), sludge bulking and foaming control, and the design of sustainable water management systems. Dr. Daigger is the author or co-author of well over two hundred technical publications, several manuals that are widely used in the wastewater profession, and four books. *Biological Wastewater Treatment, Second Edition* is a widely used graduate textbook and *Manual on the Causes and Control of Activated Sludge Bulking, Foaming, and Other Solids Separation Problems, Third Edition* is the standard reference on this topic in the industry. He has invented several wastewater treatment and reclamation processes, including the Virginia Initiative Plant (VIP) BNR process, the Step Bio-P BNR process, various coupled fixed film/suspended growth processes, and MBR-based BNR processes. He holds patents on several of these processes.

Educated at Purdue University where he received his BSCE, MSCE, and Ph.D. in Environmental Engineering, Dr. Daigger is a member of the American Society of Civil Engineers (ASCE), American Water Works Association (AWWA), Association of Environmental Engineering and Science Professors (AEESP), International Water Association (IWA), and Water Environment Federation (WEF). He is a Diplomat of the American Academy of Environmental Engineers (AAEE) and a member of the United States National Academy of Engineering (the highest honor accorded to practicing engineers in the United States). He has served on the governing boards of AAEE, WEF, the Water Environment Research Foundation (WERF), and IWA where he is currently the Senior Vice President. He has served on the scientific committee of many IWA specialty conferences and has been a frequent presenter. For WEF he served as Chair of the task force which prepared the current edition of Manual of Practice No. 8, *Design of Municipal Wastewater Treatment Plants*, Chair of the Board of Editorial Review of *Water Environment Research*, Chair of the Technical Practice Committee, Chair of the Research Symposium of the WEFTEC Program Committee and Chair of the Committee Leadership Council (CLC). He is currently serving as Conference Chair for Sustainability 2008. He has received the Gascoigne and Morgan medals from WEF, and is the only back-to-back winner of

the Harrison Prescott Eddy award. He has served as the Kappe lecturer for the AAEE, and is a recipient of the ASCE Simon W. Freese Lecture and Award. He recently completed service as Chair of the WERF Research Council.

Chairman LAMPSON. Thank you, Dr. Daigger. It just seems like it is a recurring theme that we hear that we are spending less in science and other nations are spending more.

Dr. DAIGGER. Yes, sir.

Chairman LAMPSON. Mr. Thompson.

STATEMENT OF MR. RONALD W. THOMPSON, DISTRICT MANAGER, WASHINGTON COUNTY WATER CONSERVANCY DISTRICT, ST. GEORGE, UTAH

Mr. THOMPSON. I appreciate the opportunity to be here. I am from Southwest Utah, and it is often said that it is so dry there our desert tortoises pack canteens, so water is very important, and we are in an area that is growing very quickly. We have gone from 13,000 people in 1970 to approximately 160,000 people today. One out of every four homes is owned by what we call seasonal residents, or snowbirds as we refer to them. The water conservation in the arid desert that I come from is very important. Our average rainfall is about eight inches, and in the last several years, it has been much less than that, so our district has been involved in educating the public towards water conservation.

I would just like to share a couple of observations of where I think technology has taken us today in the water-conservation arena, from my perspective. We have a wastewater treatment plant in an area where probably 70 percent of our population lives. Since 1990, our population area has more than doubled. Our inflow to that plant has increased about 15 percent.

I think that is really a combination of two factors. One is technology, the low-flow appliances, the low-flow fixtures. The second has been an extensive and hard public education programs to the people, encouraging them to conserve water and to use it more wisely.

Certainly, as we look westward and look at this nation, whatever you want to say, we are going to outgrow our water supply. It is, in fact, the lubricant that makes our economy thrive and protects and provides health and safety to our citizens, so the wise use of that water is a fact that we all have a pretty big investment in. In regards of where we are at, and the more mobile we are, we expect everyone's water supply to be adequate to meet our needs.

In regards to what the cost is, I think that if I was going to talk about anything, certainly, I think technology is important, and we actually have just put on a wastewater-reuse plant, a 10 million-gallon-a-day plant, which we integrated to a secondary system. But it seems to me, as we look at conservation, we also need to remember there is some other impacts to conservation that aren't all that great, and I want to share those.

One is that we need to remember that conservation isn't just taking every drop of water and returning none to the environment. And in our conservation plan, we actually take about 10 percent of what we conserve and put it back into environmental needs. The second thing is that we traditionally in the West have a policy that people, when they were overusing water, and we got in a crisis like

we have been in the last years with the drought, we can ask people to conserve, cut that use back, and pick up a 15 or 20 percent savings for one year, two years, or three years. The more people conserve the better job they do, the more hardened our water supply has to become, so we no longer have a surplus capacity in our water-supply system. We are using that up, and that requires, as water managers, that we have to harden that water supply.

And of course, the other issue is what is the cost. As you start encouraging people to take out turf and replace it with concrete and what is the cost of that, which in many cases, it would be significant.

To talk about what I think really works, I think education works, and we, in our district, put a lot of money into education, not just for the sake of education, but we don't believe that people will act without having been adequately educated in a lot of arenas. We have encouraged and require cities who buy water from us to have water-conservation plans that require tiered structures. We have put impact fees, so people who use more water have to pay a higher impact fee. We have entered into conservation agreements for those who will commit to use a water-wise landscape that allows them to pay a lesser impact fee. We have imposed time-of-day watering, which has saved, and then we have had improved technology. All of those, we believe, work, but I would say if you look at the whole arena, education is probably the most important single factor, because my observation is the more educated the public is on this issue, the more they buy into it, and the more they publicly support our expenditure in this arena. Thank you.

[The prepared statement of Mr. Thompson follows:]

PREPARED STATEMENT OF RONALD W. THOMPSON

Mr. Chairman and Members of the Subcommittee, Thank you for the opportunity to testify today. My name is Ron Thompson. I have been the General Manager of the Washington County Water Conservancy District in Washington County, Utah for the past 25 years.

I appreciate this opportunity

- To familiarize you with the efforts our District is putting forth to make water conservation a way of life;
- To share with you some ideas on what you can do to help those of us who deal with the everyday task of water conservation; and
- To give you my thoughts on the draft bill authored by Rep. Matheson of Utah.

Washington County is located in the extreme southwest corner of Utah. The area averages only eight inches of precipitation per year and is part of the northern reach of the Mojave Desert. In addition to a limited amount of water, we have 300 days of sunshine annually, a long growing season and a robust tourism industry that brings in approximately 3.5 million visitors each year. Water conservation is not optional for us; it is a way of life that each of our citizens must embrace.

Water Conservation Program

In the past eleven years, the per capita water use in our county has dropped 24 percent. In 2008, the District will review its Water Conservation Plan and set new goals to achieve an additional 25 percent water savings. Washington County has achieved this 24 percent reduction in water use by utilizing several measures:

- All cities have time-of-day watering restrictions.
- Each city has a block rate structure for water pricing so those using more water pay more.
- The District has implemented a county-wide impact fee for all new construction based on the size of the irrigable portion of the lot.

- Each city that purchases water from the District must have a water conservation plan in place.
- A telemetry project has been initiated that monitors diversions along the Santa Clara and Virgin rivers to minimize water loss and enhance precision in measuring water right allowance.
- Canal systems have been converted to pressurized irrigation systems thereby eliminating water loss from seepage and evaporation.

Water saving programs have been implemented which include:

- Ultra low flush (ULF) toilet rebates;
- WaterSense dishwashers and clothes washer rebates;
- An astro-turf rebate program—athletic fields and public facilities that have turf receive a rebate for up to one-half of the cost to convert it to astro-turf;
- County-wide free water checks;
- Smart Irrigation Controller rebates;
- State Water-Wise Plant List and Tagging program;
- Distribution of new arrival water survival kits;
- Water-efficient landscape workshops; and
- Training for and certification of professional landscapers in the use of water wise plants.

Education of the public is a key component to water conservation:

- The District publishes a quarterly newsletter which highlights water conservation;
- Articles and editorials are submitted to local newspapers;
- Annual water fairs are sponsored;
- A water conservation demonstration garden has been completed to educate the public about Xeriscape® principles;
- Various media venues are utilized;
- Education of the media is a priority; and
- Presentations are given to local organizations.

In addition to all these conservation efforts, the District is a member of the Governor's Water Conservation Team, a statewide program that encourages an ethic of conservation and water use efficiency.

We have made great strides in the conservation of this resource, but we have a long way to go. We will continue to provide water saving programs and to further educate the public on the value of this resource and how they should approach its use. But we need to go beyond this. Right now our District is looking at such conservation projects as waste water reuse and agricultural conversion to residential water systems.

These efforts to encourage water conservation and implement conservation projects do not come easy and they do not come cheaply. Hours of staff time are devoted just to this one component of a water district's mission. We were the first Water Conservancy District in Utah to submit a water conservation plan to Utah State. We were the first Water Conservancy District to partnership with EPA in the *WaterSense Program*.

The EPA's *WaterSense Program* has been influential in several ways and has helped us with our conservation mission in Washington County:

- It has encouraged manufacturers and distributors to produce high-efficiency water products.
- It has encouraged consumers to look for products that will save water.
- Most of all—it has given the public some practical methods for saving water. People want to save water and they want to do it in a way that will not be totally disruptive of their lifestyle. They oftentimes, however, do not know how to go about it. Education is the key. The *WaterSense Program* is educational and practical.
- Most of all, it puts the issue of conserving water on a national level, allowing both the public and private sectors to synergize their expertise in promoting the efficient use of water.

We need your continued support if we are to make further strides in water conservation. I encourage you, our elected Representatives, to continue leading the

charge on water conservation. Help us in Washington County meet our next 25 percent water reduction goal. We are working to:

- Require that secondary water systems be in place before a new housing development proceeds.
- Require government facilities to build and landscape in a water-wise manner. If government will reduce its water consumption, the public may be motivated to reduce theirs.
- Continue and enhance grant funding for water conservation measures and incentives.
- Continue funding for water conservation projects such as wastewater reuse and reverse osmosis treatment facilities.
- Provide grants to assist business such as restaurants and car washes to install water efficient technology.
- Legislate and implement tax credits for those who install high efficiency appliances.
- Provide grants for educational campaigns encouraging water conservation and the practical means to reach conservation goals.
- Provide grants to schools to enable them to initiate a water conservation curriculum. Future generations will be dealing with limited water resources and a growing demand.

We support and commend Congressman Matheson's water conservation legislation because it recognizes the challenges facing our nation today with regard to water resources:

- Our population is rapidly growing;
- Extreme water shortages are forthcoming; and
- Severe droughts will be long lasting.

It is imperative that our leaders map out a strategy that will focus efforts on water reuse, water storage, water distribution, water conservation and water education. This can only be accomplished with well-funded programs dedicated to

- Research which will give birth to technologies that will help us increase our water efficiency, and to
- Practical implementation of this research.

All the research and all the technology in the world, however, will not make a dent in our water issues if we do not educate and inform the public on the need for conservation and the methods which they can adopt to meet conservation goals.

The objective of this bill is a major campaign to educate the individual states, the water districts and the general public on the manner in which water resources are to be utilized and preserved. The English born biologist and philosopher, Herbert Spencer said "*The great aim of education is not knowledge, but action.*" We must take action and we must encourage our constituents to take action required to become totally committed to the wise use of our water resources.

Water development, management, and stabilization are the major responsibilities of a water district. Water conservation, on the other hand, is the responsibility of each and every citizen. This message needs to be driven home time and time again. It is imperative that we all come to understand that water conservation is not ordinance driven, but morally driven. We here in this room have a moral obligation to take the lead in conserving this great resource. Education of the public will give them the tools to follow suit. Thank you.

BIOGRAPHY FOR RONALD W. THOMPSON

Ronald W. Thompson is a member of the Utah State Bar and is the District Manager of the Washington County Water Conservancy District in St. George, Utah. He graduated from Brigham Young University in 1971 with a degree in accounting and received his law degree from the University of Utah in 1974.

Mr. Thompson is a past President of the Utah Water Users Association, member of Board of Directors and Chair of the Resolutions Committee for the National Water Resources Association, and Vice Chairman of the Resolutions Committee of the Colorado River Water Users. He is also a member of the Executive Committee of the Colorado River Water Users, is the President-Elect of the Colorado River Water Users, and is the Utah representative for the National Water Resources Endangered Species Task Force. Mr. Thompson serves on the Utah Water Develop-

ment Coalition and also currently serves on the Board of Directors of the St. George Canal Company and the Washington Fields Canal Company.

Chairman LAMPSON. Thank you, Mr. Thompson. Mr. Clerico.

**STATEMENT OF MR. EDWARD A. CLERICO, PRESIDENT,
ALLIANCE ENVIRONMENTAL**

Mr. CLERICO. I have taken a risk here in a brief presentation of showing you some visual images. I think it segues nice with the discussion we have just had, and I notice the bottle of water that we all have at our stands, and I ask you—recently, it was in the news how our tap water is equal in quality to bottled water, something the industry was really glad to hear. We knew that all along, but it made me stop and think, then, why are we flushing our toilets with it? And it is something I really want you to ponder, because the work I have done over the years has demonstrated that there is so much more that we could be doing that could be better. So I have invented the dual-flush toilet, which I said is the quintessential dual-flush toilet for America, but it recommends the fact that if you really were given a choice, would you flush your toilet with bottled water? Well, the answer is no, and the fact is we really don't have to be because there is many other choices available.

For the past 20 years, I have been working hard in this industry, and the progress has been good, but the progress has been slow due to the lack of innovation within the industry itself, and that is part of this conversation today around the research. I have built 30 water-reuse systems in that time frame, and the conservation aspect of these systems range from 50 percent reduction in use for residential to 95 percent reduction in use for commercial and institutional facilities.

Well, as a result of this work, this is a diagram that I don't know that we have the time to spend here, today, talking about, but essentially what we are doing is we are mining sewage and we are mining storm water, treating it, and reusing it for non-potable purposes within buildings. And there is a lot of this going on, relating to the green-building industry. In the green-building industry has really played a leadership role in innovation, but if we had the research behind that, I think the country as a whole could step up, and we are seeing other countries go faster and beyond us, and many of the products we are buying are coming from overseas because the American manufacturers aren't supplying them. But in essence, this diagram represents how you would take wastewater from within a building or within a neighborhood, treat it, and then return it directly back for flushing toilets, for laundry and for cooling towers. And we are getting tremendous results from the systems that we have of this nature, and the economics are actually playing out favorably, now, today, that there are no construction grants programs anymore, and the municipalities are starting to pay full price for the water and wastewater facilities. Now we are cost competitive.

There are many advantages. It is eliminating long collection lines and distribution pipes, which are inefficient and which leak and which are expensive. It helps us mitigate existing problems and combine sewer overflow. And we are removing nutrients, so that we are actually doing a better job of protecting the environment while

we are saving water. It is not just about water, it is about the environment and pollution in general.

The drawbacks are when you do this on a small scale, you do lose some economy of scale. You do require dual plumbing, because now you have non-potable water supplying fixtures as well as potable water. I tell you the plumbers union doesn't have a problem with this because it actually makes for a good economy. And when you start thinking about this whole green-building movement, there is a whole economy here related to what could happen if we were to innovate and move forward more. And the small systems are generally not subsidized, so we don't have the same level playing field economically because we are competing with subsidized municipal facilities.

Now, the New England Patriot's Stadium is one I put up because it was a story that came in 2000. It raised the awareness around what is possible with water reuse. The stadium has a complete water reuse system in it. It saved the stadium for the Town of Boxborough. They were going to leave if they couldn't solve this problem. It has a tremendous economic advantage to the root-one corridor if you have ever been up to that area of New England, so they could have some vibrancy, even through their water resource was diminished, in compromise. And that led them to the green-building era in Manhattan when in Battery Park City, they decided they were going to do very innovative water reuse programs as part of urban development, and we now have four operating high-rise buildings in Manhattan that are residential. We have three either in design or construction. The Solaire was the first. It was America's first gold-rated LEED building for a residential high-rise.

Over three years of data-taking, we see a 48 percent reduction in water use by comparison to a sister, modern building, using modern plumbing fixtures, and a 56 percent reduction in wastewater discharge. The difference between the two is we are evaporating a lot of the wastewater in the cooling towers, and once you start looking at the opportunities to reuse water, cooling is a big aspect. The surface hasn't been scratched yet, and there is lot of need for research there.

And as we look at these facilities, we are looking down from the roof on a park that is irrigated with reuse water, on a green roof that is capturing rainwater and reusing it within the building, and on the buildings themselves, you get a sense of how this can be tucked into very, very high density, as well as very rural areas. It is not about where you do it. It is just a matter of the fact that you can do it if you have the right momentum behind you.

This picture shows you how we build systems right into the foundations of buildings. The membrane technology that Dr. Daigger referred to has really helped us advance quickly, but there is so much more distance to go in terms of our research around energy consumption and practical applications to optimize these systems. We can't take another 20 years to advance this. We need to do something on a much more accelerated basis to be successful.

We have found that a scale of about 50,000 gallons a day, we are actually economical. We are more economical today than in New York City, continuing with city services. The City has recognized the advantage here, and they have given us an incentive for water

reuse. It is a 25 percent reduction in our water and wastewater bills, and this graph represents a building. The yellow line would be if you did water reuse, and the blue line would be if you were using city services. That would be for a large, 10 million-square-foot facility, which some of the neighborhoods in New York City are, so you can see there is an economic advantage. You go to a smaller scale system, the economics are okay, but they are not quite as attractive, and the City is now considering doing a capital-incentive program to incentivize developers to do more of this because it hasn't cost the city anything and they are benefitting from reduced demand on their water supply and on their wastewater infrastructure, and they realize that in the future. The City intends to add one million people and 750,000 jobs by 2030. And in the course of doing that they need to remove 60 million gallons a day of water consumption, which is a five percent reduction, so they know that they need innovative solutions like this if that is going to happen. And it is interesting that this is going to be happening in New York City. It can happen anywhere where water is a concern and where environmental discharges are a concern. It just doesn't have to be a one-city solution.

Research is an important component of this. As I mentioned, the energy-water nexus needs to be researched further so that as we develop our new systems, we are effective in terms of how we manage our energy relative to our water management. There are many new applications. I had mentioned cooling towers. We have interesting conversations with cooling tower manufacturers. We could surely use some university support around what could be done better to integrate the various functions of how we use water with how we can treat our water for reuse.

And that is what I have to tell you today. Thank you.

The Future of Water Reuse in America

Subcommittee Hearing

**Subcommittee on Energy and Environment
Subject: Research to Improve Water-Use Efficiency and Conservation:
Technologies and Practices**

Date: October 30, 2007

**Mr. Edward Clerico, P.E., LEED AP
President, Alliance Environmental, LLC**

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American Standard

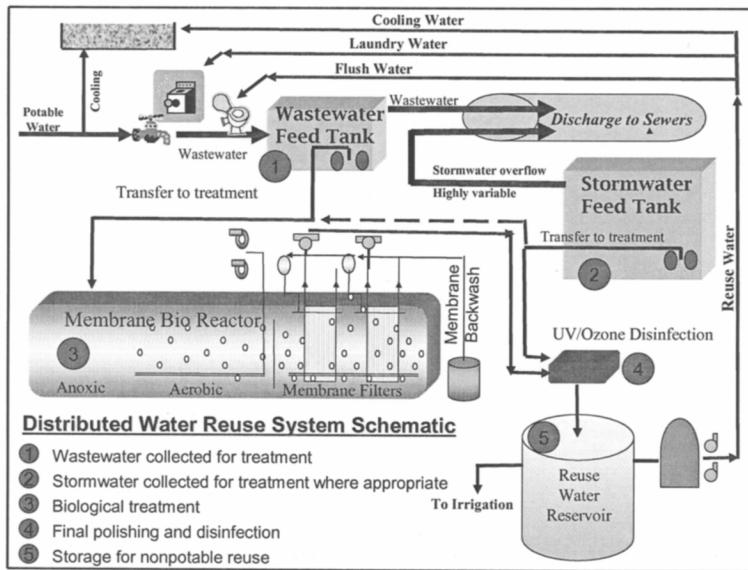


*The quintessential dual flush
toilet – What's in Your Tank?*

- If given the choice would you flush your toilet with bottled water?
- So why is this our current standard?

Distributed Water Reuse Systems

Building Type	Date of 1 st System	Water Reuse	Water Uses
Research	1987	95%	Toilet flushing
Office	1989	95%	Toilet flushing
School	1990	75%	Toilet flushing
Commercial Centers	1993	70%	Toilet flushing
Stadiums	1996	75%	Toilet flushing
Urban Residential High Rise	2000	50%	Toilet flushing, cooling, irrigation and laundry
30 Systems	20 Years	80% Reuse Nonresidential 50% Reuse Residential	



Benefits of Distributed Water Reuse

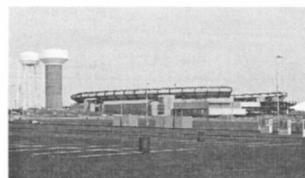
- Significant (50%-95%) reduction in demand on water and wastewater infrastructure and resources
- Eliminates problems with long distribution and collection pipelines – No infiltration/exfiltration
- Helps to mitigate Combined Sewer Overflow and Sanitary Sewer Overflow
- Removes nutrients thereby providing better environmental protection

Drawbacks of Distributed Water Reuse

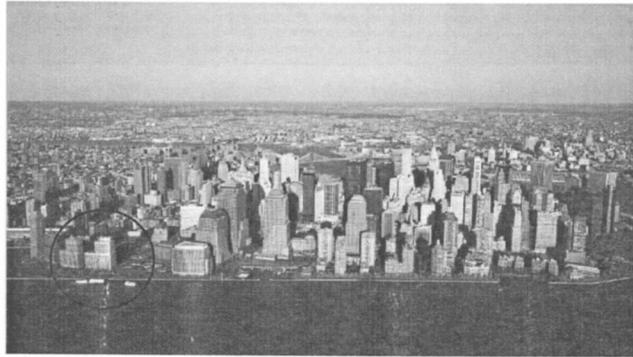
- Reduced economy of scale at small size
- Requires dual plumbing for nonpotable supply
- Not subsidized similar to conventional systems

New England Patriots Stadium Foxboro, Massachusetts

- Raised awareness about distributed water reuse
- Provided economic and environmental value



Distributed Urban Water Reuse Battery Park City – New York



The Solaire – Opened 2003

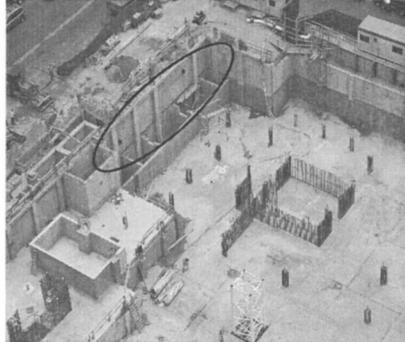
- 293 Residential Units
- 25,000 GPD WW treatment plant
- LEED™ Gold Certification
- **48% reduction in water use**
- **56% reduction in wastewater discharge**



Integrated Water Resource Management

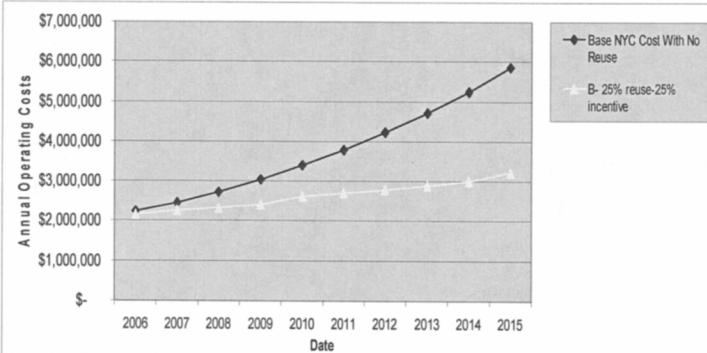


Integration With Building and Neighborhood Design

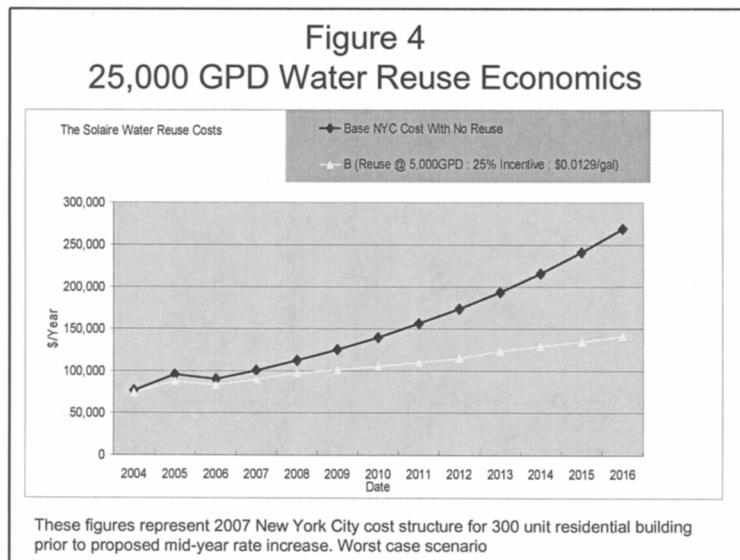


- Plan water reuses and components at outset
- Incorporate into lowest value space inside or outside building

Figure 3
500,000 GPD Water Reuse Economics



These figures represent 2007 New York City cost structure for 10 million square feet of mixed residential and commercial building space prior to proposed mid-year rate increase. Best case scenario



Demonstration and Research Needs

- Visible demonstration projects for public education and for research purposes
- Research water/energy nexus
- Research method for advancing water reuse into new applications
- Research more advanced forms of reuse that separate nutrients and water

[The prepared statement of Mr. Clerico follows:]

PREPARED STATEMENT OF EDWARD A. CLERICO

The Future of Water Reuse in America

Thank you very much for the opportunity to testify before you this afternoon on the proposed “*Water-Use Efficiency and Conservation Research Act.*” My name is Edward Clerico and I am President of Alliance Environmental and I have designed, built, operated and owned water reuse projects for the past 20 years. My recent work in Manhattan on a number of water reuse projects in high rise residential buildings has attracted considerable attention from interests across the globe. I am here today to briefly tell you of the significant success we have achieved with water reuse and how it offers tremendous opportunity for the future and how important it is to advance research on this matter.

Overview

Water reuse is not new to America and there are a number of well known large scale reuse projects that are mostly in the arid regions and they almost exclusively use treated wastewater effluent for irrigation purposes. Arguably, if this causes the irrigation of additional arid land, it does not offer any real environmental benefit but if it replaces existing irrigation supply, it does reduce the demand on water supply. Such water reuse projects are accepted by the public and they are beneficial, but the benefits are mostly seasonal and only of significant value where irrigation is in high demand.

Direct water reuse is a more beneficial and innovative approach whereby wastewater is treated and reused for multiple non-potable purposes inside and outside of buildings. This has been accomplished mostly on a distributed system basis where small to medium size facilities are built on-site to provide service to a specific customer or customer group. Typical uses are for toilet flushing, cooling tower make up and laundry uses in addition to landscape irrigation. There are 30 such direct water reuse projects in the Northeast and they span a period of 20 years. Most recently, such projects have been built in urban areas where an abundant supply of wastewater can be readily minded for treatment and reuse. The benefits of this approach are numerous:

- 48 percent to 95 percent reduction in water consumption by comparison to typical modern buildings
- 60 percent to 95 percent reduction in wastewater discharge
- Reduced environmental impact from Combined Sewer Overflows (CSO)
- Reduced nutrient and chemical loads to water bodies
- Consistent performance year round that is not dependent on geographical location or season
- Economical operations that use the waste as a resource, provide treatment at the source and yield a favorable Life Cycle Cost and Life Cycle Assessment
- Economical asset management that avoids the need for large capital projects associated with conventional centralized water and wastewater systems
- The opportunity for improved energy efficiency relative to water and wastewater treatment systems and water movement in general
- The opportunity for improved nutrient management for further environmental benefits.

By way of example, for a mixed use (residential—commercial—office) development it is very possible that the non-potable water reuse demands would nearly match the wastewater generation such that wastewater discharge can be almost entirely eliminated. Such dramatic results are not widely recognized and embraced within the water and wastewater industries for many reasons, mostly due to lack of understanding and difficulty adopting innovative models. There is a strong need for education via demonstration projects as well as research to advance knowledge within this field so that the centralized water and wastewater industry can enter this new paradigm.

Introduction

It has been reported that it takes 1,200 gallons of water per capita per day to operate the U.S. economy but the human population only consumes less than one gallon of water per capita per day. It is clear from this fact that water reuse offers

tremendous opportunity to reduce our impacts on water resources because theoretically all but the one gallon per capita per day can be readily reused. Water reuse is not new, but it is not well recognized for the potential benefits that it offers because the entire delivery mechanism for water and wastewater services in America; regulatory, financial, legal, business and physical assets, are not structured to embrace the water reuse approach. Recent experience with water reuse projects in urban, suburban and rural settings suggests that these hurdles can be readily overcome with new technology and business delivery mechanisms that deserve widespread consideration because they have proven significant environmental benefit.

Throughout the world, we are faced with a situation wherein our water resources are being depleted and destroyed as a result of:

1. Growing population and pursuit of better living conditions that include abundant use of water for many lifestyle demands
2. Increasing discharge of new products that include more complex chemical constituents that are not readily removed by traditional wastewater treatment
3. Growing anthropogenic pressures on water resources from many activities that have indirect impacts.

To date, we have approached the solution of all our water resource problems by innovating and advancing the supply and discharge mechanisms originally created by the Romans. This Romanesque approach relies upon the natural water cycle to provide the dilution and ultimate purification that protects human health. Unfortunately, what worked for the Romans is no longer suitable for modern humanity and we must take the necessary steps to establish a new perspective. The good news is that there are robust and well proven solutions available today.

If one takes a high level view our current conventional methods of water resource management, the problem becomes readily evident. Consider the following abbreviated technical description which represents our current approach to water supply and water resource management:

1. Supply—Surface and ground water provide our source of supply. These supply sources are compromised by many influences and are generally in need of treatment to remove contaminants and to provide disinfection from pathogens. Not all contaminants and pathogens are easy to identify so we constantly search for a better understanding of how to best protect our public health from many unknowns.
2. Storage—Most population centers demand more resource than can be readily supplied by the naturally available resource during dry weather periods, so we construct large reservoirs and dams to hold water to make up for natural deficits that would occur. This water impoundment approach itself has a number of detrimental affects on the environment and the water budget overall, but it is necessary and unavoidable in most cases.
3. Treatment—The extracted supply is treated, disinfected and readied for distribution. We strive to have this water as pristine as possible and recent testing has proven that it really is as “*pure as bottled water*” in almost all respects and cases.
4. Distribution—The treated supply is distributed via thousands of miles of pipes via pumping, pressure controls and intermediate storage tanks. This infrastructure is extensive, complex and is generally deteriorating and in need of repair. Pipe leakage generally accounts for a loss of about 15 percent of this rather costly resource.
5. Use—This “*bottled water quality*” supply is then brought to our homes and business where a tiny percentage is consumed, but most is used for flushing toilets, bathing, washing dirty laundry and dishes, cooling system supply in larger buildings and watering lawns and landscaping.
6. Contamination—As a result of our use, this supply is highly contaminated with feces, urine, chemical cleaners and disinfectants, dirt, unused products, industrial byproducts, food waste, grease, oil and a long list of things that go down the drain such as pharmaceuticals, personal care products, make-up, insect repellent and more.
7. Collection—in all urban and most suburban cases, this contaminated wastewater is then collected by another set of complex and cumbersome pipes and pumps that are also in need of maintenance and upgrading. Most of these pipes allow groundwater and storm water to leak into the sewage (infiltration) and some allow untreated sewage to leak out into the ground

(exfiltration). In most older urban areas and in far too many newer suburban areas these piping networks are influenced by storm water flows and ground-water such that raw sewage routinely overflows during wet weather thereby contaminating the very source that supplies our drinking water.

8. Treatment—The collection and transmission system then takes this highly contaminated water to a central treatment plant where technology has been applied to treat and remove the contaminants to the greatest degree possible. This task becomes very difficult because some contaminants are difficult and expensive to remove and these plants are in need of upgrades and cannot often comply with their requirements and customers don't want to pay for the required treatment plant improvements. There is also additional complication from the fact that new contaminants appear routinely as a result of new products that enter our market place and end up down our drains.
9. Discharge—These complex treatment systems do the best they can with the money and technology available and once fully processed, the treated water is discharged back into the water bodies that serve as the source of supply. Often, downstream neighbors remove this same water and begin this cycle all over again, in many cases with only hours of travel time.

If I were to suggest to you that you should flush your toilet with bottled water you would appropriately respond that this would be a crazy thing to do. However, this is essentially what we do under our current water and wastewater infrastructure paradigm. The above scenario could readily be condensed into the following brief non-technical description:

We utilized large scale public infrastructure to produce “bottled water” that we then use to flush our toilets and into which we dispose of our wastes, which we then send off for treatment and discharge into our water bodies, where henceforth we send it downstream for our neighbors to extract once again, produce “bottled water” and start the cycle all over again.

When population density was low and waste sources were mostly biodegradable natural contaminants, this scenario worked because Mother Nature provided the dilution, disinfection and purification needed to buffer the dangers. Now that population densities are much greater and the contaminants are much more difficult to treat, this scenario makes no sense and in the long-term must be replaced or supplemented by a more modern approach.

Direct non-potable water reuse¹ offers the alternative of creating a man-made water cycle that separates the waste flow from the drinking water supply source and it provides high quality “non-potable” water for uses that only involve waste disposal and do not threaten human health via consumption. Technological advancements allow small scale applications of treatment that can be placed immediately at the customer's location such that the wastewater can be collected, treated, stored and reused without traveling long distances and without the associated large capital investment in infrastructure. Due to the nature of this “man-made water cycle” the level of treatment is very high and the environmental impact is greatly reduced. The end result of distributed direct water reuse is a dramatically reduced demand on potable water supply, wastewater treatment systems and the water environment, plus elimination of most of the intermediary infrastructure required in conventional systems. It is a win-win throughout the water supply chain.

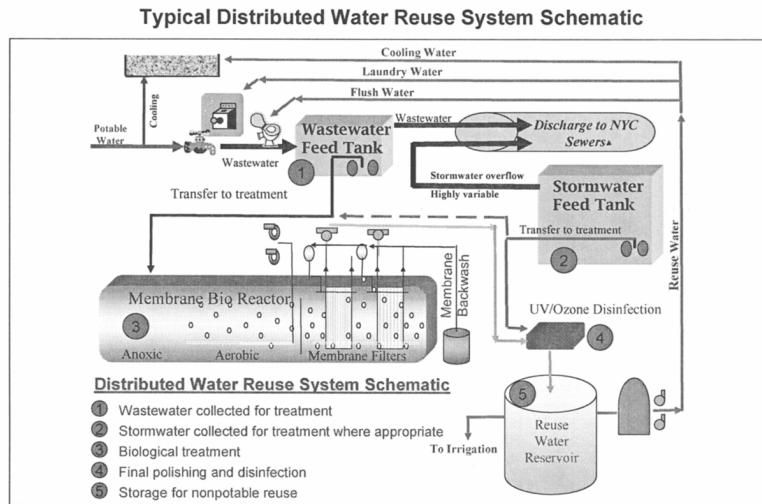
Brief History of Distributed Water Reuse Systems and Performance

This historical review is important as a means of demonstrating how distributed water reuse systems are already providing robust and safe service to a diversified range of customers over a significant period of time. The concept is not new, but as time has progressed, each new system has achieved improved results and more significant benefits. The concept is still very young with regards to development potential and there is a strong need for public education and research to build upon this successful start. Whereas it seems like we have come so far, in reality we have only begun to reveal the possibilities of water reuse that lie ahead.

The approach to distributed water reuse, sometimes referred to as wastewater mining is relatively simple, but it incorporates sophisticated advanced methods of treating wastewater such that it is completely safe and suitable for non-potable

¹ Non-potable water reuse refers to water that is produced to a quality that is safe for human contact, i.e., swimming water quality, but not suitable for drinking. Direct non-potable water reuse in this report never refers to direct reuse for consumption purposes. Direct reuse for consumption purposes would be objectionable to most Americans today even though technology now allows this as a safe practice as evidenced by new systems that are operating in Singapore.

reuse. The schematic presented below represents the current state-of-the-art relative to distributed water reuse systems. The membrane bio-reactor has become the standard biological treatment method utilized presently because it offers several advantages—small footprint, robust performance and automation capabilities. As depicted in this schematic, storm water can also be incorporated into the water reuse scheme depending on site characteristics and appropriateness of this additional source of supply.



In the mid-1980's there were a rash of sewer-bans throughout the northeast that resulted from problems associated with aging wastewater treatment plants. This was also an era of economic boom that frequently created pressure to build new developments in areas where public sewers did not exist or where they could not accommodate any additional flow. This drove developers to seek alternative solutions and as a result of this economic driver, the first water reuse system in this region was built in 1987 for a pharmaceutical company in a suburb near Princeton, New Jersey. This 350,000 SF office research facility employed over 400 workers and by recycling treated non-potable water to flush toilets, produced a wastewater discharge that was slightly more than a single family home. The results were so astounding that others soon followed suite.

By the late 1990's there were 20 similar systems built in the Philadelphia to Boston region and the applications represented a wide array of commercial, office, public buildings and one baseball stadium. Several schools were included in this portfolio which included children ranging in age from preschool to high school. Table 1 below provides a summary of these systems by age and type.

Table 1

<i>Building Type</i>	<i>Date of 1st System</i>	<i>Water Reuse</i>	<i>Water Uses</i>
<i>Research</i>	1987	95%	Toilet flushing
<i>Office</i>	1989	95%	Toilet flushing
<i>School</i>	1990	75%	Toilet flushing
<i>Commercial Centers</i>	1993	70%	Toilet flushing
<i>Stadiums</i>	1996	75%	Toilet flushing
<i>Urban Residential High Rise</i>	2000	50%	Toilet flushing, cooling, irrigation and laundry
30 Systems	20 Years	80% Reuse Nonresidential 50% Reuse Residential	

In 2000, a water reuse system was built for Gillette Stadium, home of the New England Patriots, NFL Football Team located in Foxboro Massachusetts. This system raised the awareness of many interested parties because it not only provided a means for the Town of Foxboro to accommodate a new stadium, it also allowed for a non-potable water reuse system that could provide the needed water and wastewater service to the Route 1 commercial district that is a vital component of the town's economic growth plans.

2000 was also the beginning of the Green Building movement in America and new development projects certified by the United States Green Building Council were now gaining attention. In New York City, the Battery Park City Authority had adopted strict environmental standards for the development of an area of southern Manhattan known as Battery Park City which runs along the Hudson River waterfront. Developers in this area embraced these environmental standards while also adhering to the USGBC LEED (Leadership in Energy and Environmental Design) program. Under these dual environmental programs water conservation and reuse became a key aspect of residential developments that aimed to achieve new levels of environmental excellence and demonstrate new innovations in sustainable urban development.

The first building, The Solaire, was a 293-unit residential high-rise that broke the barrier and became the first building to incorporate direct water reuse in a residential setting. This project went on to be awarded LEED Gold certification by the USGBC and is widely recognized for its environmental achievements. After beginning operation in 2003, three years of water flow data clearly illustrated that the building consumed 48 percent less water and discharged 60 percent less wastewater than a comparable modern residential building in New York City. Water reuse at The Solaire incorporated toilet flushing, cooling tower supply and irrigation of the neighboring Tear Drop Park.

Subsequently, a number of new residential buildings in Manhattan have utilized this approach and there are currently four systems operating and there are expected to be a total of seven similar residential water reuse systems by 2009. The systems simply mine sewage and treat it to produce a high quality non-potable supply source. As the bar continues to rise within this innovative green building market, new buildings continue to strive for even higher objectives. Projects now under construction include laundry supply as an additional use for reuse water and thus the performance results are expected to be even more impressive in the future.

An unanticipated benefit from this urban application of distributed water reuse is the fact that the reduced waste discharge to sewer lines helps to mitigate the effects of combined sewer overflows via lower flows and lower waste loads. Recognizing the public benefit gained from this approach the New York City Department of Environmental Protection implemented the Comprehensive Water Reuse Program in 2004 that offered building owners a 25 percent reduction in City water and sewer charges for water reuse systems that reduced demand by 25 percent or more. This

incentive helped level the economic playing field between the privately funded water reuse systems and the publicly funded City water and sewer system. Currently, a capital incentive program for water conservation and reuse is under consideration to enhance this initiative further.

As per the objectives of PlaNYC 2030, the City expects to add one million residents, 750,000 jobs and accommodate more guests while reducing water and sewage flow by 5.5 percent or 60 million gallons per day. This ambitious goal will require a number of special measures to reduce and reuse water, with distributed water reuse being one component.

Benefits of Distributed Water Reuse

There are numerous benefits to the concept of distributed water reuse systems. They are highlighted in the bullets that follow:

- Water reuse in general reduces the demand on water supply resources and facilities on a gallon per gallon basis. Distributed water reuse systems also reduce the burden on centralized wastewater facilities similarly.
- Distributed water reuse systems utilize wastewater as a resource. Because the wastewater flow increases in parallel to the increase in water demand, there is no need for very large storage reservoirs to account for droughts. The supply and demand functions are closely linked whereby the resource flow increases while the supply demand increases and vice versa.
- Distributed water reuse systems offer the ability to separate wastes from the natural water cycle by creating a man-made water cycle that captures and treats wastewater and supplies non-potable water for reuse.
- Distributed water reuse systems are located at or very near the customer, thus there is very little need for collection and distribution piping. In many cases, both rural and urban, the actual water reuse system is located within a customer's buildings and there is no need for any outside collection and distribution system. As a result, the huge problem of infiltration and exfiltration are completely eliminated.
- Because the wastewater is treated in one treatment process that produces non-potable water, there is only one treatment mechanism to handle both the wastewater and the non-potable water supply needs as opposed to separate wastewater treatment and water supply treatment facilities typically found in conventional centralized systems.
- In areas where the sewage is mined from a public sewer system, distributed water reuse reduces both the flow and waste load on the collection systems and the environment and thereby helps to mitigate combined sewer overflows and sanitary sewer overflows conditions.
- Because the reuse water must meet high quality characteristics to be suitable for reuse, it is treated in a manner that generally removes large quantities of nutrients that would mostly pass out into the environment in conventional facilities. This nutrient control aspect offers significant environmental benefit to the local water bodies that would normally have to absorb these nutrients.
- For added performance efficiency, distributed water reuse systems can also incorporate storm water as an additional water source where climate and site conditions warrant.

Drawbacks of Distributed Water Reuse

The drawbacks of distributed direct water reuse systems are few, but they present important obstacles to more widespread application.

- Water reuse requires a dual plumbing supply system, one for the potable supply and one for the non-potable supply, thus increasing the plumbing costs within buildings.
- Distributed water reuse systems are generally at a small to moderate scale and thus lose the economy of scale benefit realized by large capital projects. This drawback seems to be mitigated once the distributed water reuse system reaches a size of approximately 500,000 gallons per day of capacity which represents a neighborhood scale.
- Distributed water reuse systems are not subsidized with public funding as are centralized systems thus the costs to the customer are higher. Incentives such as that in New York City help to mitigate this difference.
- There is a general lack of understanding of distributed water reuse systems in the professional community and this approach is not routinely considered in water resource planning efforts except on special Green Building type

projects or where public water and wastewater infrastructure does not exist. There is a strong need for public education and research to document the nuances and benefits of distributed water reuse.

Economics of Distributed Water Reuse

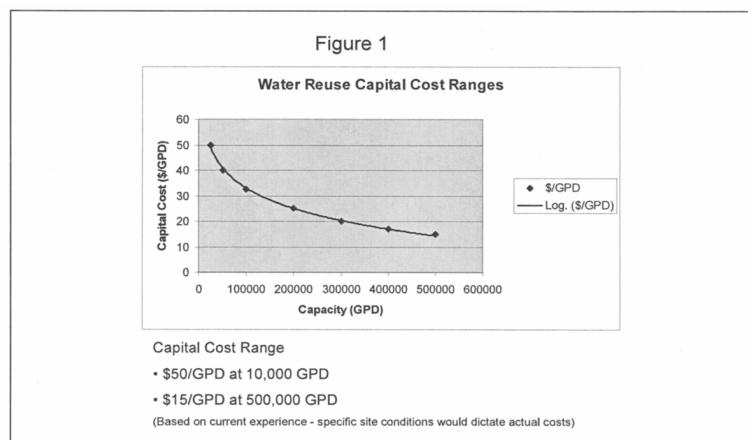
The economics of water and wastewater is not a simple matter and there are many financial influences that are difficult to fully assess. It is clearly recognized that via grants, low interest loans and other forms of public subsidies, U.S. residents generally do not pay the true cost of water and wastewater services and this creates undesirable consequences such as wasteful usage and overall lack of respect. Full cost pricing would change many behaviors and certainly influence future planning for water resource management such that water reuse would become more attractive.

The water reuse systems described herein have all been built with private funds and the capital and operating costs are not directly subsidized in any way. New York City created an operating incentive in 2004 known as the Comprehensive Water Reuse Incentive Program which provides a 25 percent reduction in City water and sewer bills for buildings that realize a 25 percent reduction in water consumption by comparison to a base building. This creates a dual level customer charge system whereby there is a conventional rate and a reduced "Green Rate" for facilities that include direct water reuse (see Table 2). To my knowledge, this is the first indirect water reuse rate incentive in the U.S.

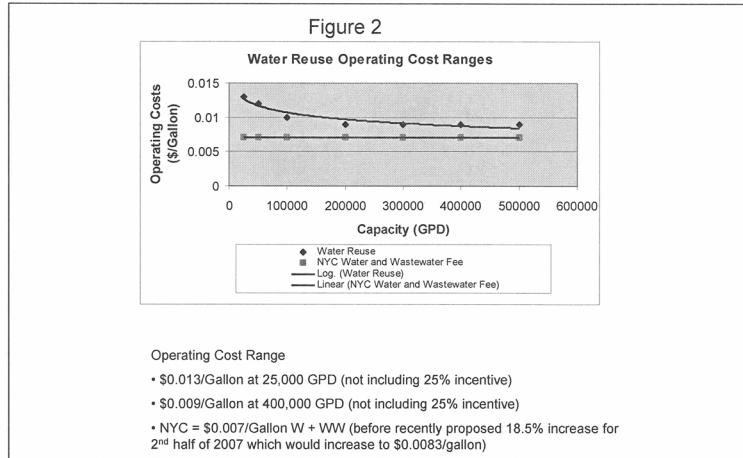
Table 2

<i>New York City – 2007 Combined Water and Sewer Rates</i>	<i>Standard Rate</i>	<i>Green Incentive Rate</i>
Current Rate	\$6.99/1,000 gallons	\$5.24/1,000 gallons
Proposed 18.5% increase	\$8.28/1,000 gallons	\$6.24/1,000 gallons

The capital cost of distributed water reuse systems varies with site conditions and size of the system. From experience, it appears that once the system reaches a size of approximately 500,000 gallons per day, it approximates the cost for municipal systems from a capital perspective at least in suburban and urban areas. In rural areas, the cost for conventional systems might be lower if the value of land is cheap. Figure 1 illustrates the variation in water reuse system capital cost as a function of system size.



From an operating perspective, costs also improve as system size increases, again with 500,000 GPD being the target operating size. Figure 2 illustrates the operating cost range based on New York City cost data.



New York City water and sewer rates are just slightly above the mean for 25 large cities surveyed.² Atlanta ranks at the top with the highest rates and Chicago at the bottom with the lowest rates. The cost effectiveness of water reuse is therefore a local matter that must reflect local costs structure and conditions. With New York representing the mean, it provides a good test case for comparison with other areas around the U.S. Figure 3 illustrates the operating cost savings for approximately 10 million square feet of mixed office and residential use comparing the conventional approach vs. the water reuse approach. As indicated in this graph, water reuse in New York City is economical presently and becomes increasingly advantageous in the future. This would represent the optimum case under current New York City cost structure.

² Reference—New York City Department of Environmental Protection, New York City Water Board Public Information Regarding Water and Wastewater Rates, April 2007—commonly known as the Blue Book.

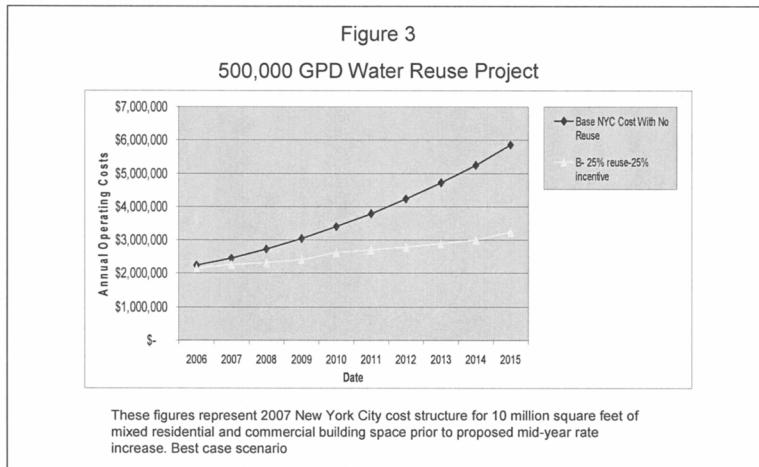
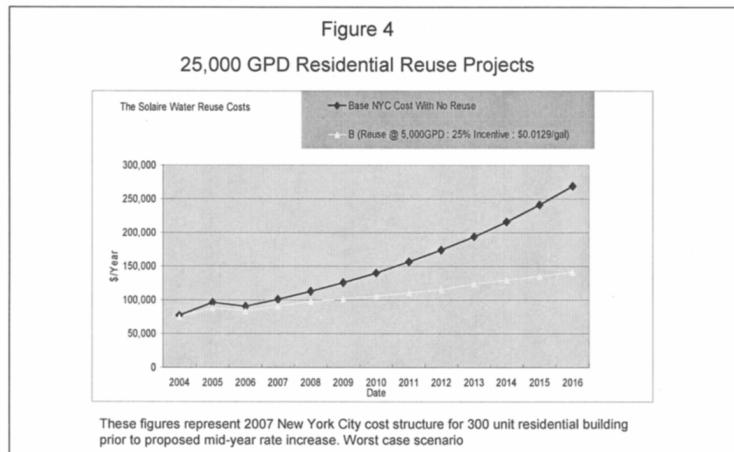


Figure 4 presents the same comparison for a smaller residential building that would include approximately 300 units. This cost information was derived from operating data at The Solaire, the first building of this nature. Ability to achieve higher levels of optimization would improve this cost picture somewhat, but even at this level, the long range picture illustrates that the distributed water reuse approach is more cost effective.



From an operating cost perspective it has been demonstrated that water reuse in an urban setting such as New York City is cost effective in the short- and long-term. From a capital cost perspective, water reuse reduces the demands on both water supply and wastewater treatment infrastructure and the costs are reasonable when comparing the potential offset in future capital spending. The difficulty with the current structure in New York City is that developers are presently funding the capital costs themselves when in many cases they are not the recipients of the future operating savings. There is therefore no incentive for the developers to implement water reuse other than for the ability to achieve new green building standards. New

York City is currently reviewing this inequity and is considering a capital incentive program that would compensate the developers accordingly. If this is implemented, the playing field between distributed water reuse and conventional centralized water and wastewater will be nearly leveled.

There are however, other considerations that reach beyond simple economics. Distributed water reuse systems offer an overall lower environmental impact so one would expect the costs to be greater, but at the moment there is no monetary consideration offered for this benefit.

Energy consumption is another area of water resource management that is not incorporated into this analysis. It is also now well recognized that there is a strong connection between energy consumption and water consumption, often referred to as the Energy/Water Nexus, which must be addressed in our future planning for both water and energy management. It is reported that U.S. citizens may indirectly use as much water turning on the lights and running electric appliances as they directly use flushing toilets and feeding water use appliances (see http://www.sandia.gov/energy-water/nexus_overview.htm). Direct water reuse offers many advantages from a water supply and environmental waste load perspective, but the energy aspects are not yet adequately quantified. The relationship between water and energy becomes even more complex as water reuse is incorporated into HVAC systems as a means of saving water, but at the same time improving energy efficiency.

According to the National Electric Testing Laboratory (NETL) 80 percent of the cost of treating, processing and pumping water is from energy (ref—Bajura 2002). Anecdotal information from existing distributed water reuse systems suggest that this electrical component is much lower (possibly as low as 40 percent) but there needs to be thorough investigation into the actual KW/gallon for both the conventional and water reuse approaches so that this relationship is well understood and incorporated into future water resource planning efforts.

Conclusion and Summary

Distributed water reuse systems must become a key aspect of our future water resource management programs because they offer so many advantages and only few drawbacks. Centralized systems will continue to serve as the backbone of water infrastructure for many years to come because so much infrastructure of this nature already exists, but future planning must include water reuse as a key component and must consider how these two approaches can be jointly optimized. Distributed water reuse systems offer a unique and compelling alternative to supplement and relieve the infrastructure that now exists and we must learn how to incorporate this approach most effectively. It will take a dedicated education, outreach and research effort for this to come to fruition.

Via water reuse, both distributed and centralized, we can accommodate a great deal of population growth and support an improved standard of living while providing better environmental protection. However, there exists a strong need to bring this new alternative to the public forefront and to fully thresh out the unique characteristics so as to build confidence and understanding.

From my perspective as an innovator I believe it is very helpful and valuable for the Federal Government to lead the way with more research in this area. It is amazing and puzzling to think about how difficult and slow our progress with water reuse has been over the past 20 years by comparison to other technology driven industries. Water is so vital for our survival, but we fail to give it the urgent attention needed to preserve the future health and well being of our society. Water reuse offers tremendous promise but it requires government support to advance more aggressively. There are many specific areas of research that would improve water reuse overall. Below are a few suggestions:

1. Create visible public demonstration projects of distributed water reuse that provide opportunities for education and research
2. Develop rigorous standards for non-potable water reuse
3. Research the energy consumption aspects of water reuse vs. conventional approaches
4. Research methods for advancing water reuse into other non-potable uses for improved efficiency
5. Research more advanced forms of reuse whereby nutrients are separated for nutrient reuse apart from water reuse
6. Develop improved membrane filtration technology to provide longer life and lower operating costs.

7. Improve aeration methods to reduce power consumption in the biological digestion process
8. Develop methods of passive treatment to reduce power consumption and operating costs
9. Advance the understanding of the uses of ozone and ultraviolet light to destroy macro molecules
10. Optimized disinfection methods to protect public health and allow more extensive uses for non-potable water.

Thank you.

BIOGRAPHY FOR EDWARD A. CLERICO

Ed is a licensed professional engineer and licensed wastewater operator in NY, NJ and PA and is a LEED Accredited Professional. He holds BS and MS degrees from Rutgers University in Bio-Ag Engineering.

Ed was the founder and President of Applied Water Management, Inc., before holding executive roles with American Water as Technical Development Director and VP Strategy. Presently he operates his own consulting business known as Alliance Environmental that focuses on Green Building Concepts.

Ed pioneered the concept of Community On-site Wastewater Systems—commonly known as COWS—and developed the first water reuse systems in the northeast region. He advocates for creating balance within our environment through innovation and environmental stewardship.

Chairman LAMPSON. Thank you, Mr. Clerico. Ms. Little.

STATEMENT OF MS. VAL L. LITTLE, DIRECTOR, WATER CONSERVATION ALLIANCE OF SOUTHERN ARIZONA; PRINCIPAL RESEARCH SPECIALIST, COLLEGE OF ARCHITECTURE AND LANDSCAPE ARCHITECTURE, UNIVERSITY OF ARIZONA

Ms. LITTLE. Thank you Chairman Lampson, Ranking Member Inglis, and Members of the Subcommittee. Thank you for the opportunity to comment on Research to Improve Water-Use Efficiency and Conservation. This hearing could not be more timely, and the Water CASA members I represent here today appreciate your leadership and your interest in the efficient uses of the water supplies throughout the Nation.

I am going to begin with a very direct statement: the cheapest source of what is that which don't have to find, buy, treat, transport, or deliver. That is sort of a credo that Water CASA works around. Regarding comments on R&D needs to enhance water-use efficiency and water conservation, first of all, we believe that this committee should use the over 200 members of the WaterSense Program, their program partners, to assist the EPA on prioritizing the specific national needs in the area of applied research.

Secondly, we believe that sound decision-making requires that national policy-makers know which areas of the country or which demographic profiles have the highest potential for increased water-use efficiency, and also which programmatic efforts or processes used in these target areas will generate the most bang for the buck. Dollars are scarce, and we have got to be very rigorous in where those dollars are allocated.

Research can provide those answers. Members of Water CASA support all of the technological efforts to save water, but we readily acknowledge the limits to technology. Human behavior factor can easily trump any technical strategy we devise through the inadequate monitoring, management, and maintenance of the technological tools. In general, water-conservation technologies are far

ahead of our ability to educate and train the users and the consumers in the effective use of these tools. A national effort to lessen this disparity is essential.

Water CASA strongly supports research efforts in the water-conservation arena that offer actual and quantifiable results, rather than projected or modeled assumption. Wise decision-making requires it.

Regarding EPA's WaterSense Program, this is an effective effort that Water CASA has supported since inception, counting ourselves among the founding promotion partners. Specifications, licensing, labeling, and publication are all great tools for us in the field, so we say do more, do faster.

Additionally, Water CASA will back any increase in training and certification efforts for all professionals in the use of the appropriate technologies touted by WaterSense. Again, the efficiency to be gained by our technologies is limited by our ability to have qualified and capable humans monitoring, managing, and maintaining them.

Regarding Representative Matheson's draft legislation, my eyes lit up when I saw the word greywater. Greywater is something we work a great deal with in Southern Arizona. The potential water savings to be had from residential greywater reuse is an estimated 35 gallons per person per day, which translated easily into 50,000 gallons per household per year. It is far too compelling a water source to ignore. National standards and regulations regarding the reuse of greywater generated in residences should be promulgated, much as we have done in Arizona.

As with greywater, the potential savings to our potable water supplies through maximum usage of harvested rainfall is astounding. In urban areas of Pima County, the amount of rainfall that could be captured from rooftops, paving landscaped areas and bare ground is equivalent to over 75 percent of the water delivered to that same urban area by the water supplier.

An Arizona model of providing incentives to increase the use of household greywater and the harvesting of rainwater can form the basis for national policy. These incentives can be tailored to motivate homebuilders, prospective homebuyers and existing homeowners as well. Water CASA agrees that water conservation should certainly be a national goal, and we welcome any opportunity to work with, not only the EPA, but with all federal agencies that have water-related mandates. We support workshops to offer input to EPA on what the national water-use efficiency goals ought to be and establishing an R&D roadmap to meet these goals.

Finally, a few suggestions that aren't directly R&D related. We believe there should be a national goal of 100 percent metered water use in this nation. We believe that all water providers should be required to have some form of conservation rate structure, whether it is a seasonal rate differential, a time-of-day pricing, inclining block rate, or surcharges tied to usage. We think that all water suppliers should be required to keep their system leakage below 10 percent of the water they deliver. And we would like to see the speed-up of the change-out of pre-1990 toilets that are high water using in existing structure thought the use of incentives, and phase in a national requirement to retrofit to HET toilets at the

time of resale, approved additional plumbing standards that reflect structured plumbing-system components that save considerable water and energy as well.

Today, the public is paying attention to water issues as never before. A national public awareness campaign is needed and needed now. U.S. federal lawmakers have the opportunity to create a national conservation ethic that reinforces the work that we do at the State and regional level.

In closing, the protection of our environmental assets, particularly our water supplies, must be given the highest consideration in all of our programmatic decision, for it actually our own self-protection and the protection of generations to come that we are doing. Thank you.

[The prepared statement of Ms. Little follows:]

PREPARED STATEMENT OF VAL L. LITTLE

Chairman Lampson, Ranking Member Inglis, and Members of the Subcommittee, thank you for the opportunity to comment on *“Research to Improve Water-Use Efficiency and Conservation: Technologies and Practices.”* With much of the country gripped by drought, this is a very timely issue and the members of the Water Conservation Alliance of Southern Arizona (Water CASA) that I represent here today appreciate your leadership and interest in the increasingly efficient use of our water supplies throughout the Nation.

Water CASA was formed 10 years ago to address many of the same issues you are grappling with here today. Members include both public and private utilities, municipalities that are not in the water business but understand that efficient water use is critical to their economic viability, our county government and our regional replenishment district. When formed, we partnered with the University of Arizona enabling us to not only provide conservation programs to our members' customers but to advocate for water conserving public policies and to do the applied research necessary to increase the effectiveness of the programs we undertake.

The good news is that living in the Sonoran desert, we have long been focused on water conservation, reducing our per-capita consumption from over 200 gallons per person per day to 150 gallons per person per day during the 1970's, long before most regions of the country were giving efficient water use a thought. The down side is that we have implemented all the inexpensive and easy programs to save water and now are very keenly aware of the difficulties and expenses that lie ahead to save that next increment of water.

RESEARCH AND DEVELOPMENT NEEDS FOR TECHNOLOGIES AND PROCESSES TO ENHANCE WATER-USE EFFICIENCY AND WATER CONSERVATION

Water CASA asks that you consider using the 200 WaterSense Program partners, working with EPA, to prioritize the specific national needs in the area of applied research. The entire water conservation community, including affiliates of the Alliance for Water Efficiency (AWE) stands ready to help. Many of my colleagues around the Nation will provide the Subcommittee with additional comments and offer you their research priorities in the days ahead.

The Nation's policy-makers need a better understanding of which areas in the country or which demographic profiles have the highest potential for increased water use efficiency. Some areas of the country have per-capita residential water use that is two or three times the per-capita residential water use in Tucson even though these areas receive two or three times the rainfall that we receive. While volumetric water use does not necessarily correlate with either efficiency or wastefulness in and of itself, these differences must be much better understood as the country goes forward facing increased drought and stressors to our water supply.

Members of Water CASA support all technological efforts to save water but we readily acknowledge the limits of technology. The human behavior factor can easily trump any technical strategy with the inadequate monitoring, management and maintenance of technological tools. The human factor is of greater consequence for many water saving technologies as compared with energy technologies (example: the highest rated irrigation system available results in extremely inefficient outdoor water use if the homeowner or landscape manager fails to properly monitor, manage and maintain that system). We now know that homes with drip irrigation systems

use 16 percent more water than homes without these systems (AWWA–Residential End-Users of Water Study, 1999). In general, water conservation technologies are far ahead of our ability to educate and train the users and the consumers in the effective use of these tools. A national effort to lessen this disparity is essential.

Because we in Southern Arizona are ahead of many areas of the country in the use of reclaimed water, we see a looming tendency to use water without maximizing efficiency in an effort to generate more effluent, and to be less frugal with reclaimed water than with the potable water supply. Some view reclaimed water as a revenue stream as much as a water source. This issue needs to be studied to assure that efforts to generate revenue do not overwhelm the need to conserve, and to ensure that the public is not paying a premium for the use and reuse of their water supply. Water CASA holds firm that the least costly water source is that which is not necessary to provide and we want decisions related to these issues to be made by our elected officials rather than water and wastewater providers who may be more focused on the potential for revenue losses rather than the potential for water savings.

National research efforts in water use efficiency needn't be limited to just the EPA (this committee). Coordination and collaboration with other federal agencies, such as the Field Services Offices and the Science and Technology Units of the Bureau of Reclamation, can assure that research efforts are not duplicated.

Water CASA strongly supports research efforts in the water conservation arena that are focused on *actual, quantifiable* water savings rather than projected or modeled assumptions. Analysis of what has worked best and the honest assessment of what has been less effective can serve to inform the research and development direction we take next. For example, we recently completed an extensive study of water conservation programs around the country; their cost and benefits, and their actual water savings (ECoBA: Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs, 2006). One of the most startling outcomes was that actual water savings for toilet rebate programs was much less than expected (15,000 gpy) at about 7,000 gallons per year as compared with the savings from toilet replacement programs which was over 26,000 gallons per year. As a result, we no longer recommend rebate programs to our members but we advocate direct install programs in areas where aging, high-water-using toilets are still in use.

WATER CASA'S PERSPECTIVE ON CURRENT FEDERAL EFFORTS TO PROMOTE WATER-USE EFFICIENCY AND WATER CONSERVATION: WATERSENSE PROGRAM OF THE EPA

The EPA WaterSense Program is a very effective effort that Water CASA has supported since its inception and we are pleased to count ourselves among the founding WaterSense Promotion Partners. Specifications, licensing, labeling, and publications are all great tools for us so we say do more, do faster! We are currently in the midst of a program that will replace 1000 high water using toilets in Pima County and we are using only High Efficiency Toilets (HET = 1.2 gpf) that are qualified to carry the WaterSense label.

Additionally, Water CASA will back any increased training and certification efforts for water related professionals in the use of the appropriate technologies touted by WaterSense. As stated above, the efficiency to be gained by our technologies is limited by our ability to have qualified and capable humans monitoring, managing and maintaining many of these technologies.

WaterSense needs to offer a grants program or research funding specifically designed to increase our understanding of the costs and benefits of conservation efforts as compared with cost and benefits of purchasing, pumping, treating, and delivering additional supplies of water. As stated above, with few exceptions, the cheapest source of water is that which you don't have to supply.

This subcommittee can set a goal to require High Efficiency Toilets (HET, 1.2 gpf or less), waterless urinals, and WaterSense rated fixtures in all new construction by 2014, as we did nationally for the ULF 1.6 gpf toilets in the 1990's. Water CASA would also strongly support a requirement that any high-water-using toilet in properties sold be retrofitted at the time of resale with HET toilets.

COMMENTS ON THE REP. MATHESON DISCUSSION DRAFT

The potential water savings from residential greywater reuse (water from showers, laundry and lavatory sinks) is far too compelling to ignore. Water CASA estimates that 35 gallons of greywater are generated by each of us every day. This translates into as much as 50,000 gallons of potable water that can be saved each year in every household that uses the greywater it generates for toilet flushing and landscape irrigation.

National standards and regulations regarding the reuse of greywater generated in residences should be promulgated. The public needs complete and accurate information regarding the safe and effective use of this water source. This effort could be modeled on the State of Arizona regulations promulgated in 2001 by our Department of Environmental Quality. Arizona requires no permit if homeowners make use of their greywater within the parameters of a set of common sense guidelines. (<http://www.azdeq.gov/environ/water/permits/download/rules/1.pdf>)

As with greywater, the potential savings to our potable water supplies through the active and passive utilization of harvested rainfall is astounding. An analysis done at the University of Arizona with funding support from EPA in 2005 (Demonstration of the Sustainability of Harvested Rainwater in Arid Lands to Meet Water Requirements, R9-03-478) concluded that in urban areas of Pima County the amount of rainfall that could be captured from rooftops, paving, landscaped areas and bare ground is equivalent to over 75 percent of the water delivered to the same urban area by the water provider.

The Arizona model of providing incentives (rebates, tax credits, development fee reductions, etc.) for increasing the use of household greywater and the harvesting of rainwater can also form the basis for a national policy. These incentives can be tailored to motivate home builders, prospective home buyers and existing homeowners as well. In Arizona, we currently offer a \$200 tax incentive (costs, up to) to home *builders* who plumb new construction for greywater capture. Additionally, we offer a \$1,000 tax incentive (25 percent of costs, up to) to home *owners* who install a greywater and/or water harvesting system.

How we achieve maximum feasible usage of alternative sources of water, both greywater and rainwater, is a topic that deserves our considerable attention and Water CASA is pleased that both of these alternative sources of supply have been put forward in this draft legislation.

Working demonstration sites can be effective teaching tools for the public if the visitation traffic is high enough. We support efforts to provide more of these types of green residential, commercial and industrial buildings (examples: Casa del Agua in Tucson, where we have compiled 20 years of water use data for a family of three, the newly opened UA College of Architecture and Landscape Architecture Addition), public landscapes (examples: The Garden in Washington County, Utah, The Water Conservation Garden in Cuyamaca, California), and planned communities.

Water CASA shares the opinion expressed in this draft bill that, water conservation should certainly be a national goal and we welcome any opportunity to work with, not only the EPA, but all federal agencies that have water related mandates. Water CASA would support a workshop or series of meetings to offer input to EPA on what the national water use efficiency goals ought to be and to assist in establishing a roadmap of research and development projects to achieve that goal.

ADDITIONAL SUGGESTIONS FOR WATER-USE EFFICIENCY EFFORTS AT THE FEDERAL LEVEL

Water CASA wishes to take this opportunity to put forth ideas that may not have been considered at the federal level. We acknowledge this is a most unique opportunity to provide input and we want to make the best use of it.

A national goal of 100 percent metered water use by all municipal water providers and a requirement for all water providers to have some form of conservation rate structure (examples: seasonal rate differential, time of day pricing, inclining block rates, surcharges tied to usage) in place by a targeted date is the highest priority recommendation from Water CASA.

Require all water suppliers (large, small, public and private) to keep system leakage below 10 percent of their deliveries. Provide a financial penalty or financial incentive to achieve this goal.

Water CASA is increasingly focused on the huge savings to be realized from increasing the effectiveness of water and energy use in plumbing systems. We suggest additional plumbing standards that embrace manifold systems, recirculating and on demand systems, the unbundling of hot and cold water lines, the insulation of all hot and cold pipes to at least R-4, elimination of plumbing pipes in slabs, smooth curves and fewer joints in all new construction. Though highly variable, the savings in water and energy by full utilization of these simply adjustments in how we plumb could achieve savings as high as 50 percent of what is currently being used.

A national public awareness campaign can have tremendous impact on the overall trend toward more efficient use of all sources of water. The need to conserve is nationwide and the entire country is paying attention to water issues as never before. Though the scarcity issues vary from region to region (salt water intrusion, aquifer depletion, rising treatment and distribution costs, groundwater contamination, drought, declining snow packs, etc.). Water CASA believes there is a key role to be

played by federal lawmakers to create a national conservation ethic that reinforces the culture of conservation work we do at the State and regional level. It is critical that the general public understands the worth, the value of water.

In closing, Water CASA wants to see national policies regarding our increasingly stressed water supplies that are equitable to all water sectors including the environment. The protection of our environmental assets must be given the highest consideration in all our programmatic decisions. We all must speak for the environment.

BIOGRAPHY FOR VAL L. LITTLE

Val Little is the Director of the Water Conservation Alliance of Southern Arizona (Water CASA). She is also Principal Research Specialist with the University of Arizona's College of Architecture and Landscape Architecture.

Val has an M.A. in Anthropology, from the University of Arizona, and has an A.B. in Landscape Architecture, from the University of California, Berkeley.

She has written numerous water-use efficiency publications including "Greywater Guidelines," published by Water CASA in May 2002, and "New Mexico Grey Water Guide," published in 2005.

Prior to her 10 years as Director of Water CASA, she was Manager of The Nature Conservancy's Hassayampa River Preserve.

Her work in water conservation and demand management has taken her to Jordan, where she worked with the USAID Water Efficiency and Public Information for Action program and the, Amman based, Center for the Study of the Built Environment.

She currently works in Central America as well, as a board member of the Nicaragua based NGO, El Porvenir.

Chairman LAMPSON. Thank you, Ms. Little. Mr. Veil.

STATEMENT OF MR. JOHN A. VEIL, MANAGER, WATER POLICY PROGRAM, ENVIRONMENTAL SCIENCE DIVISION, ARGONNE NATIONAL LABORATORY

Mr. VEIL. Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to speak to you this afternoon on produced water, an important source of water for our nation that is not currently mentioned in H.R. 3957. Over the next few minutes, I will describe some ways in which produced water is currently being beneficially reused and the need for additional research to allow further reuse of produced water.

Produced water is water that is already in the underground formation with oil and gas. When the oil and gas is brought to the surface, the produced water comes along with it. A major constituent of produced water, from the standpoint of beneficial reuse, is the salt content. Produced water is the largest volume byproduct stream associated with oil and gas production. In the United States, up to 2.3 billion gallons per day of produced water are generated. By comparison, in the D.C. Metropolitan area, the D.C. government and the WSSC provide about 300 million gallons a day of drinking water to local residents. This represents only about 13 percent of the daily produced water volume for the Nation.

There are many options for managing produced water, but today I will focus my remarks on ways in which produced water is being and can be reused. First off is underground injection for increasing oil recovery. This is the most widely used approach for managing onshore produced water. The water is re-injected back into a producing formation. It serves to maintain reservoir pressure and hydraulically drive oil towards a collection well. The practice is referred to as enhanced oil recovery or water flooding. If the oil and gas operators did not have produced water to use for this enhanced

recovery, they would need to rely on other surface or groundwater supplies to make up that water.

A second important use is agricultural. Many oil and gas wells are located in areas of the country that are characterized by arid climates and scarce freshwater resources. Produced water meeting the water-quality requirements of agricultural users offers the potential to supplement and replace existing water supplies. Perhaps the most significant barrier to using produced water for agriculture involves the salt content of the water. Most crops and livestock do not tolerate much such salt, and continued irrigation with salty water can damage the soil structure.

The third area I want to mention is use for drinking water. Texas A&M University developed a portable produced-water treatment trailer that can be moved into the oil field to convert produced water to potable water. During the past few years, this trailer has been taken out into the field in several locations in Texas for pilot studies. The water treated by the trailer met the applicable drinking water standards in every case.

There are other methods of reusing produced water, described in my written testimony. In spite of the many actual uses for produced water, a large proportion of produced water is being disposed of in ways that offer little beneficial reuse. Although some sources of produced water have low enough dissolved solids that they can be used for irrigation or for drinking with minimal treatment, most U.S. produced water has high enough dissolved solids that significant treatment must be provided before the water can be reused. Government-funded and corporate-funded research have helped develop improved technologies for removing dissolved solids from produced water. While the cost of these technologies has dropped in recent years, they are still expensive compared to the alternative of injecting produced water underground for disposal.

The bill under consideration in today's hearing is H.R. 3957. The bill promotes research, development, education, and technology-transfer activities related to water-use efficiency and conservation technologies. I fully support those goals. However, H.R. 3957 does not include any mention or consideration of produced water. Produced water is available in large volumes, often in some of the most arid parts of the country. It represents a valuable water resource. With suitable treatment, produced water can be beneficially reused to support various end uses.

I encourage the Subcommittee to carefully consider produced water as an additional source of water that can be part of the research programs envisioned by H.R. 3957. In particular, the program should support development of technologies that can remove dissolved solids so that produced water can be reused for agriculture, irrigation, human consumption or other purposes.

Thank you for your consideration.

[The prepared statement of Mr. Veil follows:]

PREPARED STATEMENT OF JOHN A. VEIL

Mr. Chairman and Members of the Subcommittee, I am John Veil, Manager of the Water Policy Program in the Environmental Science Division of Argonne National Laboratory (Argonne). I appreciate the opportunity to speak to you on produced water associated with oil and gas production, an important source of water for our nation. I am appearing today as a subject matter expert on produced water.

Through support from the Department of Energy (DOE), Argonne developed the Produced Water Management Information System (PWMIS) website (web.evs.anl.gov/pwmis) that opened for public use in June 2007. I coordinated that project and wrote most of the technical content. I have collaborated with several universities on produced water research and have spoken at numerous technical conferences on different produced water topics.

My statements reflect my own experience and opinions and are not necessarily those of DOE or Argonne. I want to share with you some information about produced water, some ways in which it is currently being beneficially reused, and the need for additional research to allow further reuse of produced water. I hope that you will consider the value and importance of produced water as you deliberate over H.R. 3957.

What Is Produced Water?

Produced water is water trapped in underground formations that is brought to the surface along with oil or gas. Because the water has been in contact with the hydrocarbon-bearing formation for centuries, it contains some of the chemical characteristics of the formation and the hydrocarbon itself. It may include water from the reservoir, water injected into the formation, and any chemicals added during the production and treatment processes. Produced water is also called "brine" and "formation water." The major constituents of concern in produced water are:

- Salt content (salinity, total dissolved solids, electrical conductivity),
- Oil and grease (this is a measure of the organic chemical compounds),
- Various natural inorganic and organic compounds or chemical additives used in drilling and operating the well, and
- Naturally occurring radioactive material (NORM).

Produced water is not a single, constant commodity. The physical and chemical properties of produced water vary considerably depending on the geographic location of the field, the geological formation from which it comes, and the type of hydrocarbon product being produced. Produced water properties and volume can even vary throughout the lifetime of a reservoir.

How Much Produced Water Is Generated?

Produced water is by far the largest volume byproduct stream associated with oil and gas exploration and production. Approximately 15 to 20 billion bbl (barrels; 1 bbl = 42 U.S. gallons) of produced water are generated each year in the United States from about 900,000 wells. This is equivalent to a volume of 1.7 to 2.3 billion gallons per day. Other countries around the world generate more than 50 billion bbl of produced water each year (nearly six billion gallons per day).

The international oil and gas industry generates about two or three bbl of water for each bbl of oil. In the United States, the producing fields are older; they produce water at a higher rate (about seven bbl of water per bbl of oil).

Why Is Produced Water Important to the Oil and Gas Industry?

The cost of managing produced water is a significant factor in the profitability of wells. The total cost (ranging from less than one cent/bbl to more than \$5/bbl) includes:

- The cost of constructing treatment and disposal facilities, including equipment acquisitions,
- The cost of operating those facilities, including chemical additives and utilities,
- The cost of managing any residuals or byproducts resulting from the treatment of produced water,
- Permitting, monitoring, and reporting costs, and
- Transportation costs.

How Is Produced Water Managed?

As indicated in the PWMIS website, responsible management of produced water follows a three-tiered pollution prevention hierarchy. Where possible, technologies that minimize the volume of water generated should be employed first. Next, options that reuse or recycle produced water should be considered. When neither of those tiers is practical, disposal remains the only viable option. I will focus my remarks on ways in which produced water can be reused.

Underground Injection for Increasing Oil Recovery

The most widely used approach for managing onshore produced water is re-injection into an underground formation. Although some produced water is injected solely for disposal, most produced water is injected to maintain reservoir pressure and to hydraulically drive oil toward a producing well. This practice is referred to as enhanced oil recovery (EOR), water flooding, or if the water is heated to make steam, as steam flooding. When used to improve oil recovery, produced water ceases being a waste and becomes a resource. Without that produced water to use, operators would need to use other surface or groundwater supplies as sources of water for the water or steam flood.

Several years ago, while preparing a widely-cited white paper on produced water, I interviewed representatives from the oil and gas regulatory agencies in three states with large petroleum production to gather statistics on underground injection of produced water. In early 2003:

- California had nearly 25,000 produced water injection wells. The annual injected volume was approximately 1.8 billion bbl, distributed as follows: disposal wells—360 million bbl; water flood—900 million bbl; and steam flood—560 million bbl.
- New Mexico had 903 permitted disposal wells, with 264 of them active. It had an additional 5,036 wells permitted for EOR, with 4,330 of those active. The approximate annual volume of produced water injected for disposal was 190 million bbl, and the annual volume injected for EOR was about 350 million bbl.
- Texas had 11,988 permitted disposal wells, with 7,405 of them active. It had an additional 38,540 wells permitted for EOR, with 25,204 of those active. The approximate volume of produced water injected in 2000 (there were similar well counts in 2000 and 2003) was 1.2 billion bbl disposed into non-producing formations, one billion bbl disposed into producing formations, and 5.3 billion bbl injected for enhanced recovery.

Injection for Future Use

When produced water contains very low salinity, it may serve as a source of drinking water. A project near Wellington, Colorado, is treating produced water from oil wells as a raw water resource that will be used to augment shallow groundwater aquifers to ensure adequate water supplies for holders of senior water rights. The oil company is undertaking this project to increase oil production. A separate company will then purchase and utilize this water as an augmentation water source. This water will eventually be used to allow the Wellington and northern Colorado water users to increase their drinking water supplies by 300 percent.

Use for Hydrological Purposes

In addition to having value as water, produced water can also occupy space or resist Earth or fluid movement. In addition to its hydrological value for EOR, other potential hydrological uses of injected produced water include:

- Controlling surface subsidence in the wake of large withdrawals of ground water or oil and gas;
- Blocking salt water intrusions in aquifers in coastal environments; and
- Augmenting the regional ground water or local stream flows.

One of the most compelling examples of subsidence resulting from oil and gas extraction involves the Wilmington oil field in Long Beach, California. Since the 1930s, more than 1,000 wells withdrew about 2.5 billion bbl of oil. Between the 1940s and the 1960s, this field experienced a total of 29 feet of subsidence, caused primarily by the withdrawal of hydrocarbons. Subsidence in the Wilmington oil field caused extensive damage to Long Beach port industrial and naval facilities. A massive repressurization program, based on the injection of water into the oil reservoirs, reduced the subsidence area from approximately 50 km² to 8 km². Approximately 2.3 billion bbl of water were re-injected through 1969.

Produced water is being considered for control of salt water intrusion in the Salinas River valley in California. This area has overdrawn ground water for domestic and agricultural uses, resulting in the salt water/fresh water interface moving six miles upstream. In this project, produced water would be discharged to the Salinas River or used locally for irrigation, thereby avoiding ground water withdrawal and reducing the driving force of the salt water intrusion.

Produced water can potentially be used to augment stream flows. Where discharges are permitted, treated produced water meeting applicable discharge stand-

ards could be directly discharged to surface water bodies. Produced water could also be injected into formations exhibiting hydrologic interconnection with surface water bodies, or allowed to infiltrate to the water table through holding ponds.

Agricultural Use

Many oil and gas wells are located in areas of the country that are characterized by arid climates and scarce fresh water resources. Produced water meeting the water quality requirements of agricultural users offers the potential to supplement and replace existing water supplies.

Perhaps the most significant barrier to using produced water for agricultural purposes involves the salt content of the water. Most crops do not tolerate much salt, and sustained irrigation with salty water can damage soil properties. In addition, if livestock drink water containing too much salt, they can develop digestive disorders.

However, not all produced water is equally salty. For example, some of the coal bed methane fields in Wyoming's Powder River Basin generate relatively fresh water. However, in addition to the salt content, the relative proportion of sodium to other ions is important because excessive sodium is harmful to soils. Soil scientists use the term "sodium adsorption ratio" (SAR) to characterize the ionic proportions.

Since produced water in the Powder River Basin frequently exhibits relatively high sodium concentrations compared to those of calcium and magnesium, the SAR of that water tends to be high. These waters can be used for some purposes without treatment, but often require either treatment of the produced water or application of soil supplements to control the SAR.

Although most of the irrigation projects using produced water are located in the Rocky Mountain CBM fields, at least one large irrigation project involving the use of treated produced water can be found in the Kern River field in central California. There, a treatment system provides about 480,000 bbl/day of water for irrigating fruit trees and other crops and for recharging shallow aquifers.

Industrial Applications

In areas where traditional surface and groundwater resources are scarce, produced water can become a significant replacement resource in some industrial processes as long as the quality of the produced water meets the requirements of the user. Produced water is already being used in some industrial applications; it may also be suitable for others.

Produced water is already being reused in some oil field applications. One company in New Mexico has treated produced water then uses it to make up drilling fluids. This beneficial reuse of produced water saves more than four million bbl per year of local groundwater. Another important oil field application is as fluid used to hydraulically fracture tight shale formations to enhance natural gas production. Each "frac job" requires huge volumes of water, in many cases more than one million gallons per frac job. In areas where natural gas fields are expanding rapidly (e.g., the Barnett Shale in Texas and the Fayetteville Shale in Arkansas), local water supplies may not be adequate to meet the demand for frac water. Produced water or "flow-back water"—the water returning from the formation following a frac job—can be treated and reused for new frac jobs.

The electric power industry uses a tremendous volume of water for cooling and other purposes. Many new or expanded power plants are facing challenges in finding adequate water supplies for use in cooling towers. Several years ago, DOE funded a project to evaluate the feasibility of CBM produced water to meet some of the cooling water needs at the San Juan Generating Station in northwestern New Mexico. The economics of using produced water at that specific plant did not appear favorable. Therefore, the utility decided not to move forward with implementation. Other applications may prove more productive, however.

Produced water has been used for dust control on dirt roads in some states. In another innovative application, firefighters near Durango, Colorado used CBM produced water impoundments as sources of water to fill air tankers (i.e., helicopters spraying water onto fires) while fighting forest fires during the summer of 2002.

Use for Drinking Water

In the past, the treatment costs to remove salinity and other parameters from produced water for purposes of meeting drinking water standards were prohibitively high. However, in recent years, costs to develop and deploy treatment technology have dropped. At the same time, communities running out of water are willing to pay higher prices for clean water. Treatment costs are approaching water prices in some cases. These developments provide the crucial incentive for many water treat-

ment technology developers deciding to enter the marketplace. A related but important issue involves managing the concentrated byproduct stream that results from treating the produced water.

Texas A&M University developed a portable produced water treatment system that can be moved into oil fields to convert produced water to potable water. This can be used to augment scarce water supplies in arid regions, while also providing economic paybacks to operators in the form of prolonged productive lives of their wells. During the past few years, the desalination trailer developed by the university conducted pilot tests using produced water from several locations in Texas. The water treated by the trailer met the applicable drinking water standards. While visiting Texas A&M University last year, I personally drank a glass of produced water treated through the desalination trailer. The water tasted fine, and I suffered no health effects.

What Can Be Done to Further Promote Reuse of Produced Water?

In the preceding paragraphs, I have summarized the resource value of produced water. In spite of the many actual uses for produced water today, a large proportion of produced water is being disposed of in ways that offer little beneficial reuse. I would like to give some thoughts on efforts that the Federal Government could consider to encourage and promote broader reuse of produced water.

Although some sources of produced water have low enough dissolved solids that they can be used for irrigation or drinking with minimal treatment, most U.S. produced water has high enough dissolved solids that significant treatment must be provided before the water can be reused. Government and corporate research has helped to develop and improve technologies for removing dissolved solids and other undesirable constituents from produced water. While the cost of the technologies has dropped in recent years, it is still expensive compared to the alternative of injecting produced water underground for disposal. Oil and gas operators have little incentive to spend more money to treat and reuse produced water when they can manage the produced water through other means. When produced water is injected for enhanced recovery, it is being put to a beneficial reuse. However, when water is injected to a non-producing formation solely for disposal, the produced water is permanently lost as a water resource.

I suggest that the Federal Government support a significant research program to develop and improve technologies for treating produced water so that it can be reused. In particular, the program should support development of technologies that can remove dissolved solids so that produced water can be reused for agriculture, irrigation, or human consumption. This will help to provide valuable fresh water resources for areas that have insufficient fresh water.

Most technologies that treat produced water to remove dissolved solids start with salty water as the input and end with a clean water stream and a concentrated brine stream as outputs. Management or disposal of the concentrated brine stream is another important consideration that can have a substantial impact on both cost and feasibility of the technology. Any produced water technology research program should include evaluation of brine management.

Expanded reuse of produced water can be expedited not only by technology improvement, but also by careful evaluation of several policy aspects. One barrier to reuse is potential liability to the oil or gas company. If an oil or gas company treats its produced water, then gives or sells the water to an end user (e.g., a municipality or a rancher), the company may later be sued by the end user if a person or a farm animal suffers ill effects. I hosted an oil and gas industry water meeting in 2005. The final session was an open discussion of how to turn produced water into a resource. Representatives of several oil companies indicated that the largest barrier was the corporate concern of liability. Corporate legal staff have been reluctant to approve some beneficial reuse projects because of the concern for litigation. As part of Congress' evaluation of legislation to enhance reuse of produced water, consideration of liability issues may help to expand reuse applications.

A second potential barrier is the interplay of water rights with ownership or control of the produced water before and after treatment. As long as produced water is perceived as a waste or a byproduct, there is little demand for it. However, after the water has been treated so that it has a value, there may be competing demands for the water, potentially creating disincentives for treating the water.

How Does Produced Water Relate to H.R. 3957?

The bill under consideration in today's hearing is H.R. 3957, the *Water-Use Efficiency and Conservation Research Act*. The bill promotes "research, development, education, and technology transfer activities related to water use efficiency and conservation technologies." I fully support those goals. However, H.R. 3957 does not in-

clude any mention or consideration of produced water. As I attempted to explain in the preceding paragraphs, produced water is available in large volume, often in some of the most arid parts of the United States. It represents a valuable water resource. With suitable treatment, produced water can be beneficially reused to support various end uses. I encourage the Subcommittee to carefully consider produced water as an additional source of water that can be part of the research programs envisioned by H.R. 3957.

Thank you again for the opportunity to address the Subcommittee.

BIOGRAPHY FOR JOHN A. VEIL

John Veil is the Manager of the Water Policy Program for Argonne National Laboratory in Washington, DC, where he holds the rank of senior scientist. He analyzes a variety of energy industry water and waste issues for the Department of Energy.

Mr. Veil has a B.A. in Earth and Planetary Science from Johns Hopkins University, and two M.S. degrees—in Zoology and Civil Engineering—from the University of Maryland.

Before joining Argonne, Mr. Veil managed the Industrial Discharge Program for the State of Maryland government where he had statewide responsibility for industrial water pollution control permitting through the National Pollutant Discharge Elimination System (NPDES), Underground Injection Control (UIC), and oil control programs. Mr. Veil also served as a faculty member of the University of Maryland, Department of Zoology for several years.

Mr. Veil has published many articles and reports and has made numerous presentations on environmental and energy issues.

DISCUSSION

Chairman LAMPSON. Thank you very much. Even though it is not mentioned in this legislation that we are talking about here, there is legislation Representative Hall has introduced and this certainly should be given serious consideration in this bill.

At this point, we are open for our first round of questions. The Chair recognizes himself for five minutes.

THE NEED FOR GOVERNMENT-FUNDED R&D

I would like to ask of Dr. Daigger first, and then, perhaps, all of you may want to comment on this. It is just a general question. But in your testimony, you write “The United States led the world in developing and implementing revolutionary water-management systems throughout the second half of the 20th century. The question before us is whether the U.S. is going to give up its leadership in this critical area. And this is the path that we are on, but I can be reversed with a fairly modest set of actions by the Federal Government.”

Can you talk for a bit about what those actions are that would reverse this trend? And the rest of you, feel free to chime in.

Dr. DAIGGER. Yes, Mr. Chairman. I appreciate the question, because from my perspective, it really goes to the heart of the matter here. The question is how much investment in R&D will help translate some of the wonderful advancements that are occurring in some of the fundamental sciences into advances that then can be picked up by the private sector and delivered to consumers.

I mentioned membrane technology as an example and Mr. Clerico showed you an example of how membrane technology in its current form is being applied in some very innovative ways. That technology, though, is really just the start. We look at the advances that are occurring in things like nanotechnology and biotechnology, what is needed is some investment to help take those advances and

for our water sciences to translate that into the fundamental research that will apply to the water industry, so that those can be further converted into higher-performing systems that will fit into the types of applications that Mr. Clerico described.

You might ask why private industry wouldn't fund that slice of research. The answer is that the benefits of that research will be broadly available, and it is not possible for private industry to capture the return on that particular investment. Once that research is completed, though, it will allow private industry to build the businesses and so forth, and through tax revenue, to repay the public investment. We have seen this time and time again in this country, and this is the model that countries like Singapore and Korea are adopting and that countries, like Canada and France, have used in the past.

The other aspect of this is because we haven't had for the last several years funding of this type of research. To a certain extent, we are starting to lose the academics because a successful academic needs research to publish, and they need research to fund their students. And the \$20 million that I mentioned is actually—we have a working group within the Water Environment Federation that is looking at the need for professionals in the future. That is based on some fairly rigorous math in terms of the funding for faculty and therefore students to provide the professionals that we need to continue forward.

Finally, this is something which the U.S. Federal Government has done in the past, and it was that research that allowed us to develop the systems that have benefited the country. It has created the opportunity for us to serve the rest of the world. I have every confidence that with support from the Federal Government that the innovation engine can be restarted, both to our benefit, in terms of water resources, but again, it will pay itself back in terms of the economic activity that it develops.

Chairman LAMPSON. Anyone else want to comment?

Mr. CLERICO. Very briefly, and just to supplement, not to repeat anything. There is also the research component to deal with developing standards in the public health aspect. In my regards, with regards to water reuse, it has been a long, hard fight to convince people that this really works, and if there was the research to develop national standards, which the rest of the world has always looked to us towards in being leaders in adopting these types of standards. We are starting to look to other countries that are developing the standards before us, and I don't think that is healthy.

USER REACTIONS TO WATER REUSE PROGRAMS

Chairman LAMPSON. How about the social barriers to implementing various reuse programs and policies. Would you talk about that for a minute? How does the acceptability of technologies impact their use, and how can the Federal Government help to encourage Americans to use existing technologies?

Mr. CLERICO. I have seen, specifically through my experience particularly with the green-building movement, people's willingness to innovate, in terms of their willingness to use new things. The water reuse systems we have in place are in some of the highest-value properties you are going to find, and they are acceptable in

those applications. I think we have broken the barrier around acceptability because it has been going on for enough years in places where I don't think anyone can question it is not going to be good enough for me because it has been good enough already for people long enough.

So I think the research would just help us educate more people quicker. As I said, we just can't take another 20 years. It has been a long, hard fight.

Chairman LAMPSON. Thank you very much. My time has expired, and I now recognize Mr. Inglis for five minutes.

Mr. INGLIS. Thank you, Mr. Chairman.

DO WE NEED MORE R&D OR BETTER IMPLEMENTATION?

Ten years ago, when we were building a house, I asked our builder about putting in a greywater system, and I think I asked when the septic people were present, too, and they looked at me like I had grown an extra head or maybe some other appendage, thinking of what? And I said to them maybe we could reuse some of the water. Basically, it was a nonstarter, shall we say? This wouldn't work right. There would be no real need to.

So to some extent, necessity is the mother of invention, especially if you are in some arid climate, like where you are from, rather than South Carolina. We are at the top of the water streams. We drink it, and we flush, and then it goes down the river. We were ready to start there at the top of the streams, and maybe everyone figures, well, we have got plenty, so we will just keep doing it the way we have been doing it.

So it occurs to me that really what is going to drive this is necessity, right? I mean if you are in Arizona, you really need to do something, if you are in South Carolina, at the headwaters, maybe it is not so imperative, or you don't feel that it is.

And then, Ms. Little testified that the greatest impact is going to come from human behavioral change rather than technology. So I wonder if that being the case—I think that is probably true, that really what is going to happen is that when people decide that this is something that they want to do. Maybe I should have insisted ten years ago on a greywater system. Of course, I couldn't afford the irrigation system that would go with it, so it would have been just sitting there all of these ten years, but we would have been putting it in the drain field, I guess.

But anyhow, I am wondering about the efficacy of this research. I trust that research will give some breakthroughs, but it is being done in a lot of places. For example, Furman University has a very exciting project in their science building. It is a way they are going to flush, and then it is going to come back into the building as drinking water, after going through all of these greenhouses and really amazing things. So apparently, this technology is here now. It is available, right? So can you tell me a little bit more about why we need to research it, when it looks like what we really need to do is just apply it, and the applying it is human behavior, and the human behavior is driven by a felt need, right?

So does anybody want to respond to that?

Mr. CLERICO. Well, I think it is a confidence issue, and it is being done, but it is not being done in a widespread nature, and it is just

like the green-building movement in general. A lot of things are starting to happen, but they are going to take time, and there is just so much we could do to advance this in a more creative way and in a more open way so that people would have confidence in what we are doing and so that we could continue to learn. We have just scratched the surface, so I wouldn't say let us stop here because it is already being done. We have demonstrated that really creative things can be done, but there is so much more, if we want to be leaders in this, that I suggest we need to move forward aggressively, as opposed to just watching everyone else do it.

Mr. INGLIS. Dr. Daigger.

Dr. DAIGGER. Actually, I have some familiarity with South Carolina as well. In the mid-90s, I was on the faculty at Clemson, so upstate South Carolina is an area that I know, and actually they could have some relatively significant water problems during dry periods and so forth.

You ask a very, very good question, and I think there is an aspect here that we haven't quite articulated. There are a number of ideas and a number of elements of paradigm change in terms of how water can be managed. And you have spoken to some of them in terms of greywater and so forth. Each of us have spoken to an element of it. It is a little bit like the seven blind men trying to describe the elephant, in the sense that it is the combination of several of these ideas that can really transform and provide a dramatic change and a dramatic improvement in terms of how water is managed. And until a number of these elements come together, the profession, and I use that term broadly, it is those folks on a broad basis that make decisions about water management. Until some of these systems come together on a larger basis, folks won't get it in terms of how all of these different things can come together into a new paradigm.

I was very pleased to see in the bill the proposal to do demonstrations, because demonstrations are the aspect that can help pull several elements together to see how a more integrated system can perform at a much, much higher level. You know, in the U.S., we use about 150 gallons per person per day. That could easily be cut to a third or a fifth.

And if you think about, then, how much more security we would have in terms of drought-proofing, and also, quite frankly, how much better off the environment would be if we just left that water in the environment. Many places, including some instances in upstate South Carolina, one of the biggest environmental impacts we have in the water environment is just the amount of water we take out. It is not just the quality; it is the quantity. So where this bill would really help is from the demonstration side, that will help to provide—you know, we are all tactile learners. We have to see and feel and work with systems. That is really where that will help how these various systems can come together in terms of a system that can perform at a much higher level.

Chairman LAMPSON. Ms. Giffords, you are recognized for five minutes.

Ms. GIFFORDS. Thank you, Mr. Chairman.

WATER CONSERVATION TECHNOLOGIES AND PRACTICES

It seems to me that we are all pretty much on the same page. The big challenge is how do we get these ideas out to the public? How do we get the public-private cooperation and the partnership at the local, State, and federal levels?

And these are big challenges, particularly for those of us who are in the West. And actually, from the University of Arizona, Dr. Swetham was on 60 Minutes just last week talking about forest fires and what is happening with the impact of global warming on the West. So it is really widespread, and our challenge, of course, as policy-makers, is how do we derive the best and the brightest ideas.

So I would actually like to turn it over to the panel, starting with Val Little. All of you have had a chance to talk about some of these creative avenues you have taken, but I was just hoping that each of you would tap into some of the best ideas that perhaps, we, as a committee, can glean and pull those ideas forward. I know this all related to Representative Matheson's bill, and this would be an idea, but if you could, please, touch on those, starting with Val and what you are doing with Water CASA.

Ms. LITTLE. We are very big in the area of greywater reuse, and to respond to Congressman Inglis's dilemma about building his house, greywater may not be the answer for every house. In his particular part of the country, it may be harvesting rainwater. Certainly, there is a lot more rain there than we get in the arid Southwest, so maybe that would be the appropriate innovative technology for you to have tapped into.

There is no one-size-fits-all, and there is no easy answer. One of the things that we try to look at in a balanced way within Water CASA are all of the tools. There is no easy answer. Rates won't solve all of the problems. Research won't solve all of the problems. Technology won't. Public information won't. But all of the tools that we work with together, it has to be comprehensive, and it has to be consistent. That is what I think the opportunity is for all of you, maybe not just with this bill, but certainly this is a beginning, and this is something which to build on.

Particularly regarding greywater. It is driven by the public in that particular region that wants to reuse their water. They instinctively understand in a desert environment like that, where many of the laundry facilities are very readily accessible, and they have one mesquite tree or one very tough tree, it makes very good common sense to say, why wouldn't I use those 35 gallons of water today and provide increased shade for my house by using my laundry water. So it a very simple driver. It is not complicated, reclaimed water systems. It is driven by the public who had a thirst to know. They wanted to know how to do it, and that is what we have worked toward.

Mr. THOMPSON. I would like to add to that. It seems to me you really have a two-pronged problem in terms of how you deal with it. In our State of Utah, we don't allow greywater systems, which I certainly think we should. So you have the education of regulators and those who determine who can do what within their community, and then you have the general education of the public.

I watch several agencies struggle with the reuse concept, because there is no question, technologically. We can take our wastewater systems, treat that water, and bring it back in a quality that is drinkable. The public acceptance of that has not been well received. They have accepted reusing that water in their parks and on their lawns and in their gardens and golf courses and many other places, which takes the pressure off our water supply. So there are other things you can do.

I still think that in the long-term, to really be successful, you have to have a very aggressive public education system. In our district, we educate fourth or fifth graders, between 2,000 and 3,000, every year, in what we call a water fair. We spend time with the teachers in the public education system. We think it ought to be part of the required curriculum, but the school district has been very good in working with the district in those programs to bring all of the kids to the university campus. They spend a whole day on water, whether it is what it takes to treat it or the various aspects of water reuse, and where it comes from and how it gets to their tap.

Secondly, we have been aggressive, not only in our area, but in Utah, for some time in what we call the Governor's Water Conservation Program, which is funded by the bigger water districts in the state. We encourage people to use water more wisely, and we have a series of ads that start, usually as people start using water, talking about time-of-day watering, and the simple things we can do in our house to save water.

And third, I think you have to follow that up with local landscape ordinances, education of the people, the builders, and the other parts of your community who really control what is going to happen in this arena, so that they realize that those options are there and how they can use them and implement them within their own business.

Several years ago, as we developed our water-conservation plan, we had the builders. The biggest builder in the community sat on a citizen's taskforce. I have watched him for the last decade, as I have watched his communities build out, and they have become much more water-conservation oriented, more desert landscaping and so forth. He would not have done that—his earlier developments were all water features and lush lawns and lakes. He has changed dramatically, and I think it has been to both the benefit of the community and to him economically.

So there are a lot of things that are really, still, in my mind, hands-on public education because people won't act until they are educated. And once they understand it, often, you know, they usually make the correct decision, and my experience is when people understand the facts, they almost, inevitably, make the correct decision.

Ms. GIFFORDS. I know we are out of time, and perhaps the other panelists can weave the answer into your questions later, but let me just say, in Tucson, where I am from, we have an initiative on the ballot right now that potentially could be really devastating for economic development, and it is a scare tactic of toilet-to-tap. And what we see, particularly in the area where you can have initiatives is that the public is moving forward. They are going to shut

down development and growth, unless we, as policy-makers, are really smart about this. We will know in a couple of weeks what happens with our initiative in Tucson. Those states that have the ability for the voters to get out and put their own legislation on the ballot, we have got some real concerns unless we step up and address the real problems.

Chairman LAMPSON. And I was in a meeting yesterday, and my district in Texas, where we were talking about stopping development because we have too much water. And from another part of Texas, in Rockwell, I recognize the gentleman, Mr. Hall.

HYDRAULIC FRACTURING AND ENHANCED OIL RECOVERY

Mr. HALL. Thank you, Mr. Chairman, I have kind of a couple questions. First, Mr. Veil, you said that most produced water is injected into underground formations to maintain reservoir pressure and for enhanced oil recovery. And I will get back to that in a minute. How do I associate the word fracking with that? In our area, we hear that a lot when the wells are low and they go back with a special way to get some of the oil that is left there. Have you included all of that into your description that, according to your testimony, it is injected there for enhanced oil recovery, or is it there for some other reason, disposal or use? Or are there other uses for the water? And are those three connected in some way?

Mr. VEIL. They are connected somewhat. The fracture water that you mentioned, there is a process known as hydraulic fracturing, where you pump large volumes underground.

Mr. HALL. And electrofracture and water fracking.

Mr. VEIL. Right, and the purpose is to make cracks in the rock so that either the oil or the gas can more readily flow toward the well where you collect it. In certain very tight shale formations, such as the Barnett shale in Texas, the Fayetteville shale in Arkansas.

Mr. HALL. That is the one I am thinking about.

Mr. VEIL. In order to make them productive, you have to take incredibly large volumes of water for the fracture job. I have visited some in Arkansas where they are using more than one million gallons per frack job, and it is hard to find that kind of water. When you are fracking five, ten wells, it is okay, but if you are fracking hundreds of well, you need to find that water from somewhere. So produced water may serve as a source of water to be partially cleaned and put back in the ground for energy production.

Mr. HALL. In Barnett, they are not drilling directly through there for some reason. Maybe it is the massiveness of it or something. They are slanting from around it, as I understand it.

Mr. VEIL. I think that is a strategy to try to produce more gas from one well, but I can't be sure on that.

Mr. HALL. I am for that if it is on my 500 acres, which, I doubt, it will be.

But how would enhanced oil recovery be effected if produced water was used in some other capacity, for instance as a non-potable reused water?

Mr. VEIL. I believe that there is plenty of produced water to go around. If we ended up in a situation where you couldn't use pro-

duced water for enhanced recovery, and you had to find something else, that wouldn't create an issue.

Mr. HALL. And I might ask this: in my bill that the Honorable Chairman mentioned a moment ago, H.R. 2483, I included a section for research and development for produced water technology, and I have in my bill to give the R&D program to the Department of Energy. Do you have any thoughts about that, as to whether that is appropriate for this type of R&D to be maybe in the EPA or the Department of Energy? I have always preferred the Department of Energy over the EPA, but I probably may not have thought that one through. What is your idea on that?

Mr. VEIL. Well, sir, I am going to respectfully decline to answer that in that it is a matter of policy rather than technical matters, and I defer to the judgment of the panel in this case.

Mr. HALL. Well, that is what we have the panel for. But I accept that. But if you ever run against me, I am going to use it.

I yield back my time. Thank you, sir.

Chairman LAMPSON. Thank you, Mr. Hall. He would be a good politician, though.

Mr. HALL. Yeah, he would be all right.

Chairman LAMPSON. I recognize Mr. McNERNEY for five minutes.

CUSTOMER SATISFACTION WITH GREYWATER SYSTEMS

Mr. MCNERNEY. Thank you, Mr. Chairman.

Ms. Little, how satisfied are customer households that have greywater systems installed? Is that something they like or is it a problem for them?

Ms. LITTLE. Because it is their option, no one is required to have it, they are very satisfied. They self-sort into households that want to be more water conserving. They have a high conservation ethic, and they really want to do the right thing, and they have great pride in their individual systems. Most of them have been developed specifically by them, for them.

And I would say the least satisfying part of all of our efforts with greywater is the lack of qualified installers and analysts. We get more calls from people saying we need a plumber, we need someone to come and tell us how to, than we do anything else. And there is a dearth of proper plumbers. And we need green plumbers.

Mr. MCNERNEY. Do you think that would be the case if it was required for a city or for a city to have greywater? Do you think the satisfaction level would be equally high?

Ms. LITTLE. I think that, overall, the majority of the population is not ready yet. And one of the reasons that we worked on a bill to get houses plumbed to accommodate greywater at some later date is because of the huge growth spurt we were in. And in order to get those houses plumbed at the time of construction, which is very inexpensive to do, knowing full well that households who might not even know what greywater is now, five years from now, they will be very disappointed if they can't access their sources of greywater and reuse them as costs go up and the climate for water changes.

GREYWATER SYSTEM COSTS

Mr. MCNERNEY. Thank you. Mr. Clerico, what do you think the incremental cost is in terms of a new house for implementing the greywater system, maybe in a percentage, if you could think of it?

Mr. CLERICO. The parties that have been involved with this, it is probably about a one percent incremental cost on capital for the residential buildings we have been involved with. They are multi-family. They are not single-family homes. It is going to be very site specific to the exact use. One of the natures of this business is it is very specific to the use and to the technology that is adapted. We have seen about a one percent, but in the long-term view, as I showed in the slide, we are seeing a very bright economic picture going forwards. It is just that initial capital cost.

CAN WE DRINK PRODUCED WATER?

Mr. MCNERNEY. Mr. Veil, I have a question about produced water. Is there technology that would clean this for residential use, or is it too contaminated to be sent into a residence?

Mr. VEIL. Produced water, much like other sources of industrial water, can be cleaned. It depends on how much you want to spend to clean it, in order to get it clean enough for drinking purposes. That has been the problem so far is the cost of getting out sufficient pollutant has exceeded the cost of being able to inject it somewhere for disposal, so there has been no incentive on the oil-company side to do it that way.

COST OF OTHER FORMS OF WATER TREATMENT

Mr. MCNERNEY. Thank you. Dr. Dagger, you mentioned membranes, UV and oxidation. How cost-effective are those, and how do they compare, say to desalinization?

Dr. DAIGGER. Well, the membranes are one form of desalinization. For example, the type of membrane that Mr. Clerico was showing in his system is called an ultra-filtration membrane, which is one which separates the pores are large enough to separate out particles but not to filter out dissolved solids. A reverse-osmosis membrane, which would be used for desalinization, has pores which are at the molecular scale, and therefore, can separate out dissolved constituents. So the desalinization and membranes are somewhat synonymous in the sense that membrane technology, today, is what is used, but a specific type of membrane system.

Mr. MCNERNEY. So the desal is roughly competitive, cost-wise, then? I mean, you are saying they are basically two kinds of the same—

Dr. DAIGGER. The difference is that the pressure required for a particle-separation membrane might be on the order of, let us say, three or four pounds per square inch. For a reverse osmosis membrane, it might be 150 pounds per square inch. So the amount of energy that is required is significantly different to desalinate compared to the other types of membranes, and they are somewhat more expensive to handle that higher pressure and so forth.

I might say that, for membrane technology, you know, over the last ten years, the costs of membranes have come down about ten-fold over the last ten years. That is starting to plateau out in terms

of cost because the new generations of—for example nanotechnology and so forth. The critical need to take the advances that are occurring in, for example, nanotechnology, do that slice of research that will bring it into the water industry, I think you can see one tenfold reduction, and how that can change the game. Another tenfold reduction could, again, really change the game, and that is the type of opportunity that there is for us to really transform how we manage water.

Mr. MCNERNEY. Thank you.

Chairman LAMPSON. Dr. Bartlett, you are recognized for five minutes.

Mr. BARTLETT. Thank you very much. I feel something of a kinship with the panel. I noted that Mr. Thompson is from Washington County. I represent the first Washington County in the Nation, in Maryland, and Mr. Veil got one of his Master's degrees from the Zoology Department at the University of Maryland. And I suspect that before you were born, I got my Master's there in '48, and my doctorate in 1952. So I feel something of a kinship with the panel.

I would like to note that the solution to pollution is dilution is probably no longer a very supportable process with our diminishing water supplies. You know, we are one of the few counties in the world that flushes its toilets and washes its streets and waters its lawns and washes its cars with drinking water.

I had mentioned that to our local water people because I wanted to do something else. In a former life, I was a homebuilder, and they said, oh, gee, they might drink out the hose. And my response was, you don't drink out of the toilet do you? You don't drink from the toilet, so you don't drink from the hose if you are using greywater, right? It is a matter of education, I think.

I have had a concern that in all of the development that doesn't have public water and sewer access. We are consuming farmland and because the water has to percolate, and in our area, they won't even give it a percolation test if it slopes more than 25 percent. So if the water percolates and the land doesn't slope more than 25 percent, that by definition is farmland, so I wanted to demonstrate that you could live very comfortably without doing that. I wanted to build a house that had composting toilets or constructed wetlands so you don't need any connection to the Earth for that. And I wanted to build a home where I used rainwater, because in our area, we have about 40 inches per year, and that is quite enough water to meet all of your needs. And they told me, well, we can't do that because that is cistern water, and we don't drink that. We don't drink rainwater. I said, well, of course, we drink rainwater. The rain falls on the hog lot, and then it runs into the stream, and the stream runs into the reservoir, and then you pull it out and treat it and tell me its drinking water. I said can I please have the water before it goes through the hog lot? And you know, they responded with some sanctimonious drivel about they had a responsibility to protect the public health. So my question is what can we do with these mindless bureaucrats so we can use these really current technologies to conserve water?

Ms. LITTLE. Could I comment? I would like to comment. I share your pain. We started with a regulatory agency who said, oh, no,

no, no, we can't possibly do that. And I will tell you that the research that we did that we put into the hands of our regulatory agencies that caused them to change their minds, the hardest thing to do was to get them to fund a study of lawbreakers. Essentially what we wanted to do was look at people who were doing this because they knew it was the right thing to do, but they were doing so illegally. That being said, you have to keep at it, and you have to convince them, just as you did. I think anybody who just heard your statement would say, in a commonsense way, it does make sense. I know what goes into my own water. I know what goes into my own laundry. I know what goes out on my yard. It makes a great deal of sense to do it. It doesn't have to be complicated. It doesn't have to be high tech.

Mr. BARTLETT. Actually, the systems are very simple, and I built a home that had a greywater system in it. We separated the black water from the greywater, and even with the increased price of oil, those plumbing things are still very cheap. It adds very little to the cost of a house, if you do it when you build the house.

Mr. Chairman, I would like to think about some federal legislation. I know, big government guy, but sometimes you have to do something that encourages our local jurisdictions to adopt some of these technologies. You know, you could build a home and live very comfortably on the Tarmac with composting toilets and constructed wetlands. And by the way, the water that comes out of the constructed wetland, if you have at least two tiers of that, it is good, potable drinking water. They really work very well. The water that falls on the roof of the house, if you have any meaningful sized house, meets all of your water needs, even without much conservation. If you don't take it and put it in your cistern, then it becomes a problem, doesn't it? It is not called storm-water runoff, so we built reservoirs to impound it and so forth.

What we are doing isn't just dumb; it is really dumb. And we need some education so we change, and any advice that you can give us on the kind of bill that we ought to draft here to encourage our local jurisdictions to adopt these new technologies would be much appreciated.

Thank you very much, Mr. Chairman, and I yield back.

Chairman LAMPSON. A city who couldn't afford a water-treatment facility created a system of wetlands that they, in turn, turned into a tourist attraction for bird watching, and so I would be happy to work with you on your legislation to encourage or incentive communities to explore this.

Mr. BARTLETT. Thank you. Up in Pennsylvania, there is a small community of I think a dozen homes or something, and it has a constructed wetland. It is a small fraction of this room, and it treats all of the water from all of those homes. And to do it in an individual home takes a very small space to do a constructed wetland. It really works very well, and it can be a very attractive garden. It doesn't have to be a swamp. You can actually walk over it if you put the proper kind of material over it and build it properly.

Nature does a great job, you know. The water runs off of that hog lot, and by the time gets down, percolates through the ground and gets into a spring, it is now pure drinking water. By the way, John Stossel did a study in which people blind taste-tested, Mr.

Chairman, and more people prefer tap water than they did bottled water. When they actually analyzed it, the tap water turned out to be higher quality than most bottled water. This is a huge rip-off. Everybody believes it is the right thing to do.

Chairman LAMPSON. How much is it a gallon?

Mr. BARTLETT. About 3.50. It is more than oil. At \$92 a barrel, water in the grocery store is more expensive than oil. Thank you.

Chairman LAMPSON. Congressman Matheson, you are recognized for five minutes.

Mr. MATHESON. Thanks, Mr. Chairman. I just want to make a couple of comments, and I want to ask questions.

First of all, Mr. Veil, I appreciate your suggestion for other items that ought to be considered in the legislation, and I say to the whole panel, that is really the purpose of this legislative hearing. We are putting a bill out there in draft form. As the author of the bill, I am certainly open to suggestions. I think this whole committee is, and that is the spirit of the science committee always is to try to put together the best bill that promotes public policy, and so beyond your opportunity for direct communication today, if you have any written comments, following, on what you think we ought to be doing with this bill, I would certainly solicit that from you because we want to make this bill as good as it can be.

And secondly, I think it is important to note that this water issue really is relevant as a national issue. We saw data showing that 36 states in this country are projecting some type of water shortage in the next five years, and so while we have got witnesses from Arizona and from my State of Utah, which are known as being dry and arid states, the fact of the matter is that this is an issue that encompasses the whole country.

And one of the two features of this bill that I would just like to highlight is the technology-transfer section of the bill because the idea here is that there are a lot of ideas that have implemented around the country. We want to create a clearinghouse to make sure that everyone can benefit from those ideas. Dr. Bartlett just talked about a small town in Pennsylvania that did something with the wetland opportunity. There are lots of anecdotal stories out there, and the notion of trying to combine that local, on-the-ground knowledge and letting people benefit from them is one of the primary motivations behind the technology-transfer section of the bill.

WATER CONSERVATION AND THE WATERSENSE PROGRAM

A couple of question I would like to ask really quickly: Mr. Thompson, you mentioned in your testimony that in your county, the per capita water use has dropped by 24 percent in the last 11 years. Could you give us a quick rundown of which policies or practices really made this water reduction happen?

Mr. THOMPSON. Yes, I think it was a combination of maybe three or four things. Well, first of all, all of the cities put in tiered pricing. We ended up with time-of-day watering which made dramatic improvements. We are in the hot desert, so daytime temperatures, sometimes, are 110, 115 degrees, so we restricted any outside landscape watering, and then general public education to make the public aware of the need to conserve and that they had a public trust to do that.

Mr. MATHESON. And I understand that the Washington Water Conservancy District was the first district to partner with the EPA in its WaterSense Program, is that right?

Mr. THOMPSON. We certainly are the first one in Utah.

Mr. MATHESON. And has that—how has that WaterSense Program helped you in terms of pursuing the water-conservation goals?

Mr. THOMPSON. We are fairly new. You know, it is not an old program, so I think the thing that they bring to the table is that they have done a lot of research, in, particularly, upgrading the fixtures and appliances and building codes and influencing those codes which have resulted in reduced per capita consumption, particularly the new construction. You take a county like mine—you know we are going for \$160,000. Most of those homes are new homes, so we are getting the benefit of those research in implementing the low-flow toilets and structures that have benefited by new construction.

Mr. MATHESON. I wanted to ask one question, also, about—I mentioned the technology transfer when I was just—in a couple of brief comments before I went to these questions. Do you, as a local water manager, see benefits to setting up this database from the EPA to allow this to happen?

Mr. THOMPSON. Absolutely. I think it is—one of our great mistakes anywhere is we too often try to reinvent the wheel. It would be nice knowing somebody else has invented it, and take advantage of that, and so I think anytime we can get shared ideas so we don't have to reinvent those, it is a benefit to all of us.

Mr. MATHESON. Okay. Well, I appreciate the panel coming here today, and Mr. Chairman, I will yield back.

Chairman LAMPSON. Thank you, Mr. Matheson.

I thought this was very informative. Thank you for all coming. I appreciate the questions from the Members. We got some ideas. Maybe something will come to fruition from some of those. We will work on it. Again, we thank you for your time and your knowledge and your information.

Under the rules of this committee, the record will be held open for two weeks for Members to submit additional statements and any additional questions that they might have for the witnesses, and with that, this hearing is now adjourned.

[Whereupon, at 3:40 p.m., the Subcommittee was adjourned.]

Appendix:

ADDITIONAL MATERIAL FOR THE RECORD

SECTION-BY-SECTION ANALYSIS OF
H.R. 3957: THE WATER-USE EFFICIENCY
AND CONSERVATION RESEARCH ACT 2007

Purpose: To increase research, development, education, and technology transfer activities related to water use efficiency and conservation technologies and practices at the Environmental Protection Agency (EPA).

Section 1: Short Title

This bill works to create a water-use efficiency and conservation research and development program within EPA's Office of Research and Development.

Section 2: Findings

Section 2 outlines the findings of the bill and draws the connection between what EPA is currently doing in its WaterSense Program and how EPA's scope should expand in reaction to increasing water shortages across the country.

Section 3: Research Program

Section 3 directs the Assistant Administrator to establish a research and development program within the Environmental Protection Agency's Office of Research and Development to promote water efficiency and conservation. The program should address water storage and distribution systems; and behavioral, social, and economic barriers to achieving greater water use efficiency. In addition, the program should research technologies and processes that enable the collection, treatment, and reuse of rainwater and greywater. The project areas of the program should reflect the needs identified by local and State water managers.

Section 4: Technology Transfer

Section 4 directs the Assistant Administrator to collect and disseminate information on current water-use efficient and conservation practices at the non-federal level. This information should include incentives and impediments to development and commercialization, best practices, and anticipated increases in water use efficiency resulting from the implementation of these processes.

Section 6: Report

Section 6 directs the Assistant Administrator to transmit reports to Congress which detail the progress being made by the Environmental Protection Agency with regard to the research projects initiated and the outreach and communication activities conducted.

Section 7: Authorization of Appropriations

Section 7 outlines a five-year authorization.

[DISCUSSION DRAFT]

OCTOBER 18, 2007

110TH CONGRESS
1ST SESSION**H. R.**

To increase research, development, education, and technology transfer activities related to water use efficiency and conservation technologies and practices at the Environmental Protection Agency.

IN THE HOUSE OF REPRESENTATIVES

Mr. MATHESON introduced the following bill; which was referred to the Committee on _____

A BILL

To increase research, development, education, and technology transfer activities related to water use efficiency and conservation technologies and practices at the Environmental Protection Agency.

- 1 *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*
- 2 **SECTION 1. SHORT TITLE.**
- 3 This Act may be cited as the “Water Use Efficiency
- 4 and Conservation Research Act”.

1 SEC. 2. FINDINGS.

2 Congress finds the following:

3 (1) Between 1950 and 2000, the United States
4 population increased nearly 90 percent. In that same
5 period, public demand for water increased 209 per-
6 cent. Americans now use an average of 100 gallons
7 of water per person each day. This increased de-
8 mand has put additional stress on water supplies
9 and distribution systems, threatening both human
10 health and the environment.

11 (2) Thirty six States are anticipating local, re-
12 gional, or statewide water shortages by 2013. In ad-
13 dition, climate change related effects are expected to
14 exacerbate already scarce water resources in many
15 areas of the country.

16 (3) The Intergovernmental Panel on Climate
17 Change's 2007 assessment states that water stored
18 in glaciers and snow cover is projected to decline, re-
19 ducing water availability to one-sixth of the world's
20 population that relies upon meltwater from major
21 mountain ranges. The Intergovernmental Panel on
22 Climate Change also predicts droughts will become
23 more severe and longer lasting in a number of re-
24 gions.

25 (4) Water conservation should be a national
26 goal and the Environmental Protection Agency

1 should work with nongovernmental partners to
2 achieve that goal. The Environmental Protection
3 Agency should support the research, development,
4 and dissemination of technologies and processes that
5 will achieve greater water use efficiency.

6 (5) WaterSense is a voluntary public-private
7 partnership program established by the Environmental
8 Protection Agency to promote water efficiency
9 by helping consumers identify water-efficient
10 products and practices. The Environmental Protection
11 Agency estimates that if all United States
12 households installed water-efficient appliances, the
13 country would save more than 3,000,000,000,000
14 gallons of water and more than \$17,000,000,000 per
15 year.

16 (6) The WaterSense program has developed a
17 network of partners, and therefore can disseminate
18 the results of research on technologies and processes
19 that achieve greater water use efficiency.

20 **SEC. 3. RESEARCH PROGRAM.**

21 (a) IN GENERAL.—The Assistant Administrator for
22 Research and Development of the Environmental Protection
23 Agency (in this Act referred to as the “Assistant Adminis-
24 trator”) shall establish a research, development, and

4

1 demonstration program to promote water use efficiency
2 and conservation, including—

3 (1) technologies and processes that enable the
4 collection, treatment, and reuse of rainwater and
5 greywater;

6 (2) water storage and distribution systems; and
7 (3) behavioral, social, and economic barriers to
8 achieving greater water use efficiency.

9 (b) CONSIDERATIONS.—In planning and implementing the program the Assistant Administrator shall
10 consider—

11 (1) research needs identified by water resource
12 managers, State and local governments, and other
13 interested parties; and

14 (2) technologies and processes likely to achieve
15 the greatest increases in water use efficiency.

16 **17 SEC. 4. TECHNOLOGY TRANSFER.**

18 The Assistant Administrator, building on the results
19 of the activities of the program established under section
20 3, shall—

21 (1) facilitate the adoption of technology and
22 processes to increase water use, water efficiency, and
23 conservation; and

5

1 (2) collect and disseminate information on tech-
2 nologies and processes to increase water use and
3 conservation, including information on—
4 (A) incentives and impediments to develop-
5 ment and commercialization;
6 (B) best practices; and
7 (C) anticipated increases in water use effi-
8 ciency resulting from the implementation of
9 specific technologies and processes.

10 **SEC. 5. GREEN INFRASTRUCTURE DEMONSTRATION
11 PROJECTS.**

12 (a) IN GENERAL.—As part of the research, develop-
13 ment, and demonstration program under section 3, the As-
14 sistant Administrator shall carry out at least 4 projects
15 under which the Assistant Administrator provides funding
16 for the incorporation into a building of the latest water
17 use efficiency and conservation technologies and designs.
18 (b) CRITERIA.—Of the 4 projects described in sub-
19 section (a), at least 1 shall be for a residential building
20 and at least 1 shall be for a commercial building.

21 (c) PUBLIC AVAILABILITY.—The designs of buildings
22 with respect to which funding is provided under subsection
23 (a) shall be made available to the public, and such build-
24 ings shall be accessible to the public for tours and edu-
25 cational purposes.

1 SEC. 6. REPORT.

2 Not later than 18 months after the date of enactment
3 of this Act, and once every 2 years thereafter, the Assistant
4 Administrator shall transmit to Congress a report
5 which details the progress being made by the Environmental
6 Protection Agency with regard to—

7 (1) research projects initiated by the Agency;
8 (2) demonstration projects initiated by the Agency;
9 Agency; and
10 (3) outreach and communication activities conducted by the Agency.

11 SEC. 7. AUTHORIZATION OF APPROPRIATIONS.

12 There are authorized to be appropriated to the Assistant Administrator for carrying out this Act—

13 (1) xx for fiscal year 2009;
14 (2) xx for fiscal year 2010;
15 (3) xx for fiscal year 2011;
16 (4) xx for fiscal year 2012; and
17 (5) xx for fiscal year 2013.